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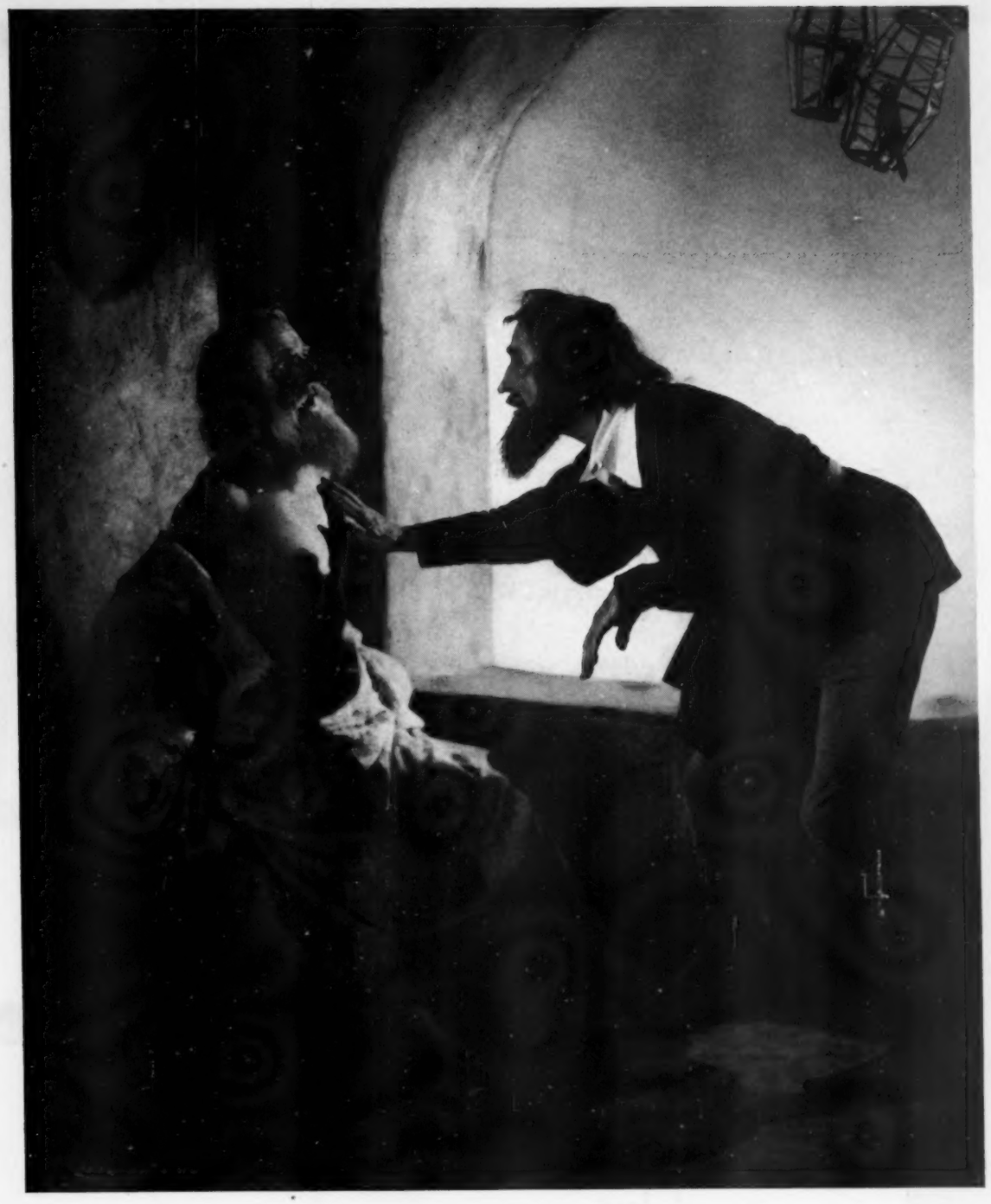

John of Arderne
(1307-1390)

SUTUREGRAM

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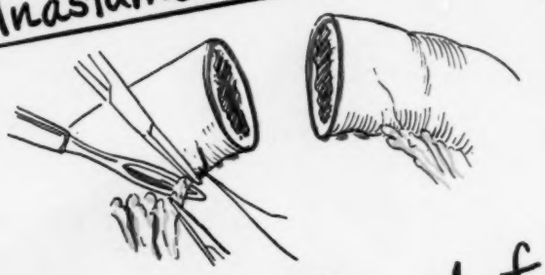
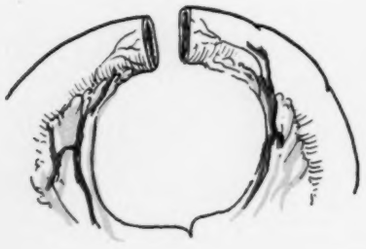
Anastamosis of Intestines



Serosa carefully cleaned of fat and mesentery for distance of one inch on either side.



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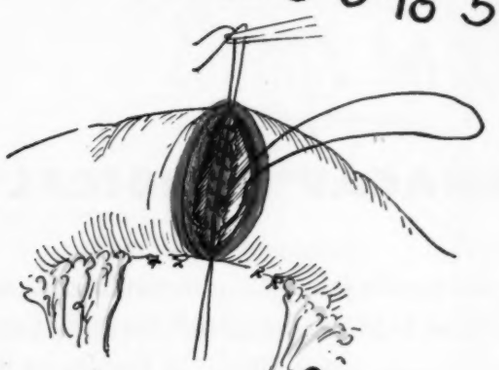
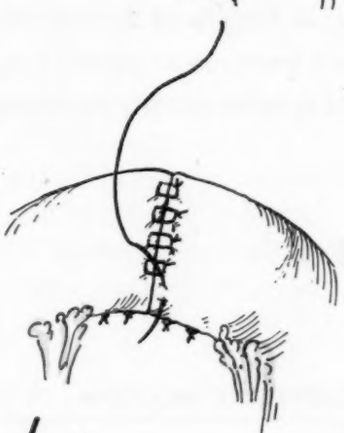
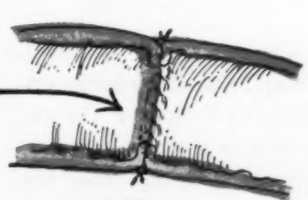


Serosa approximated by interrupted horizontal mattress silk suture 3-0



Lumen maximal



Cuff small

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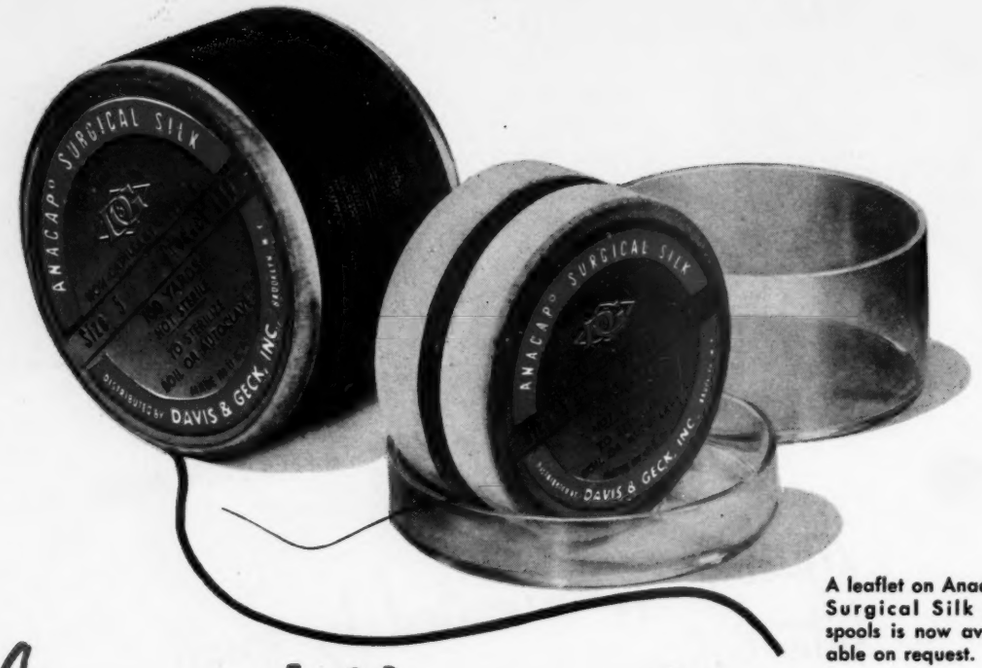

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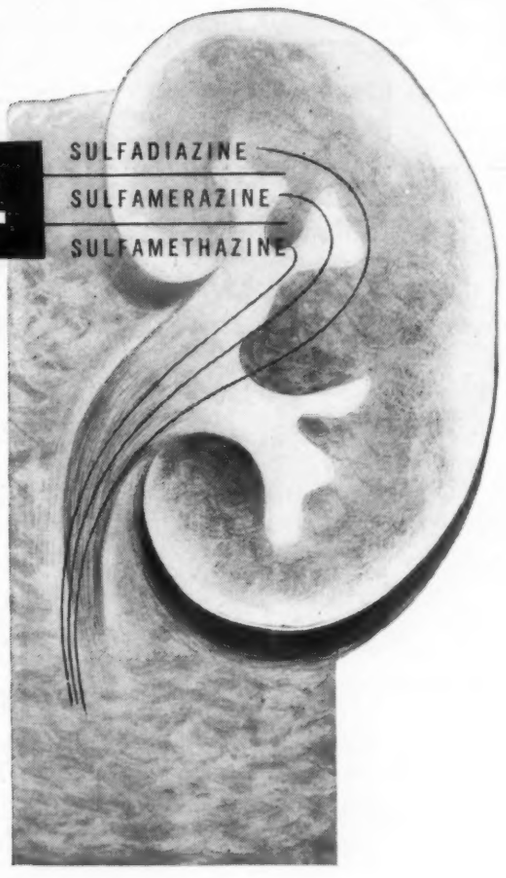

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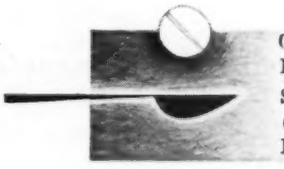

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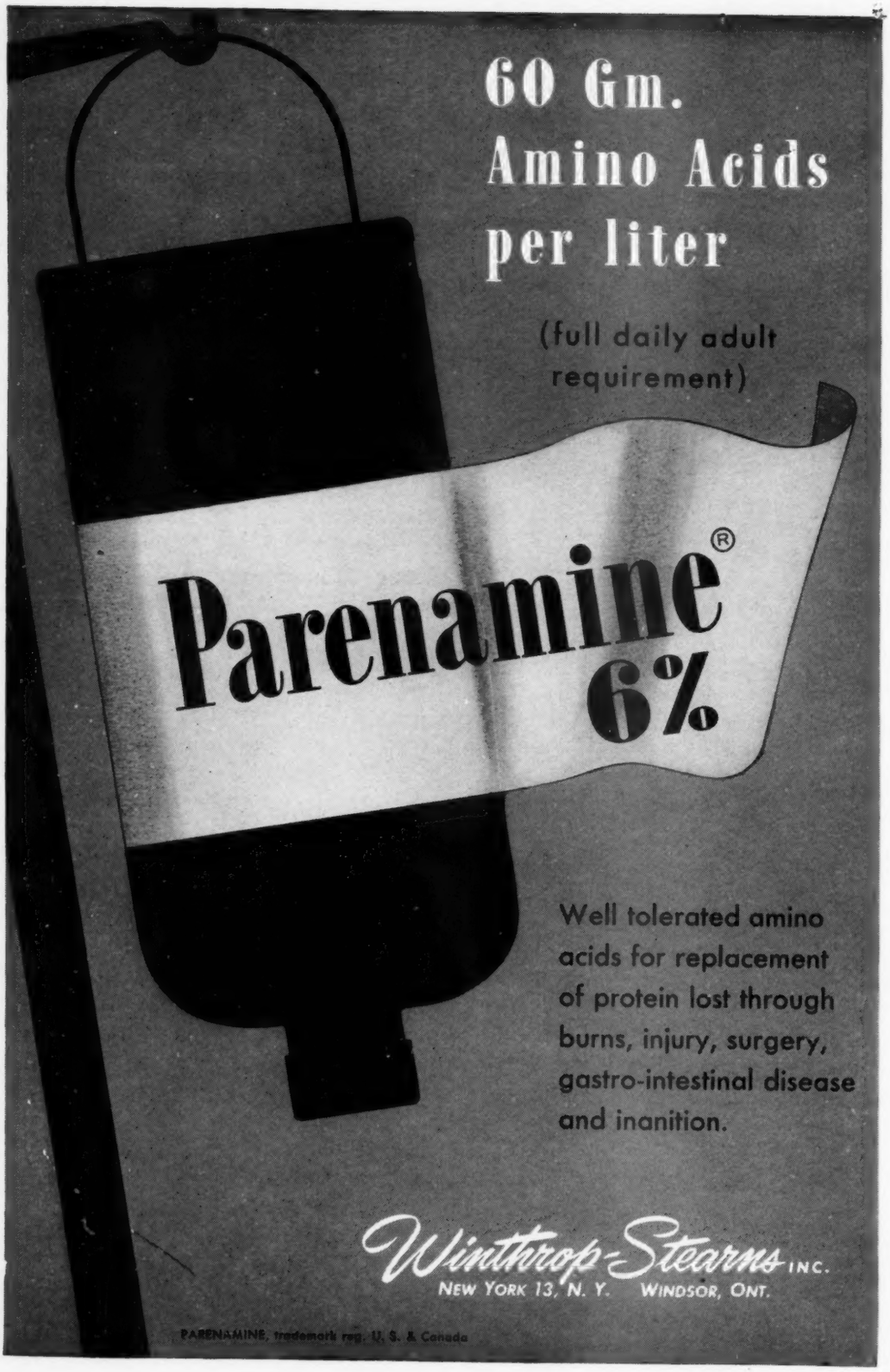
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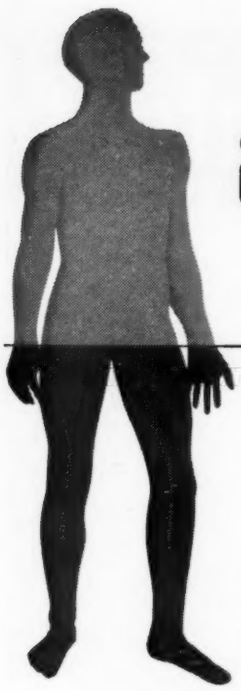

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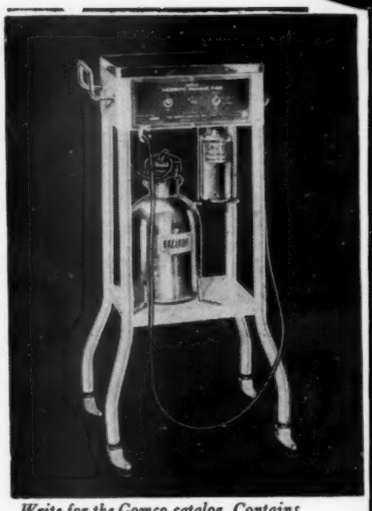

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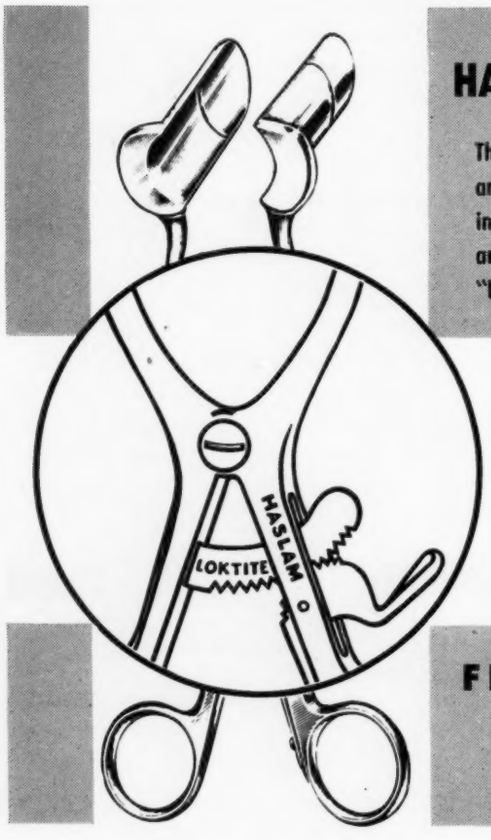

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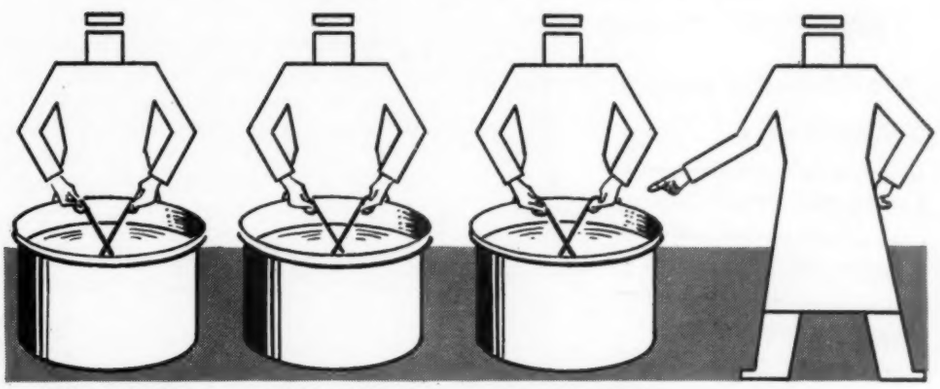

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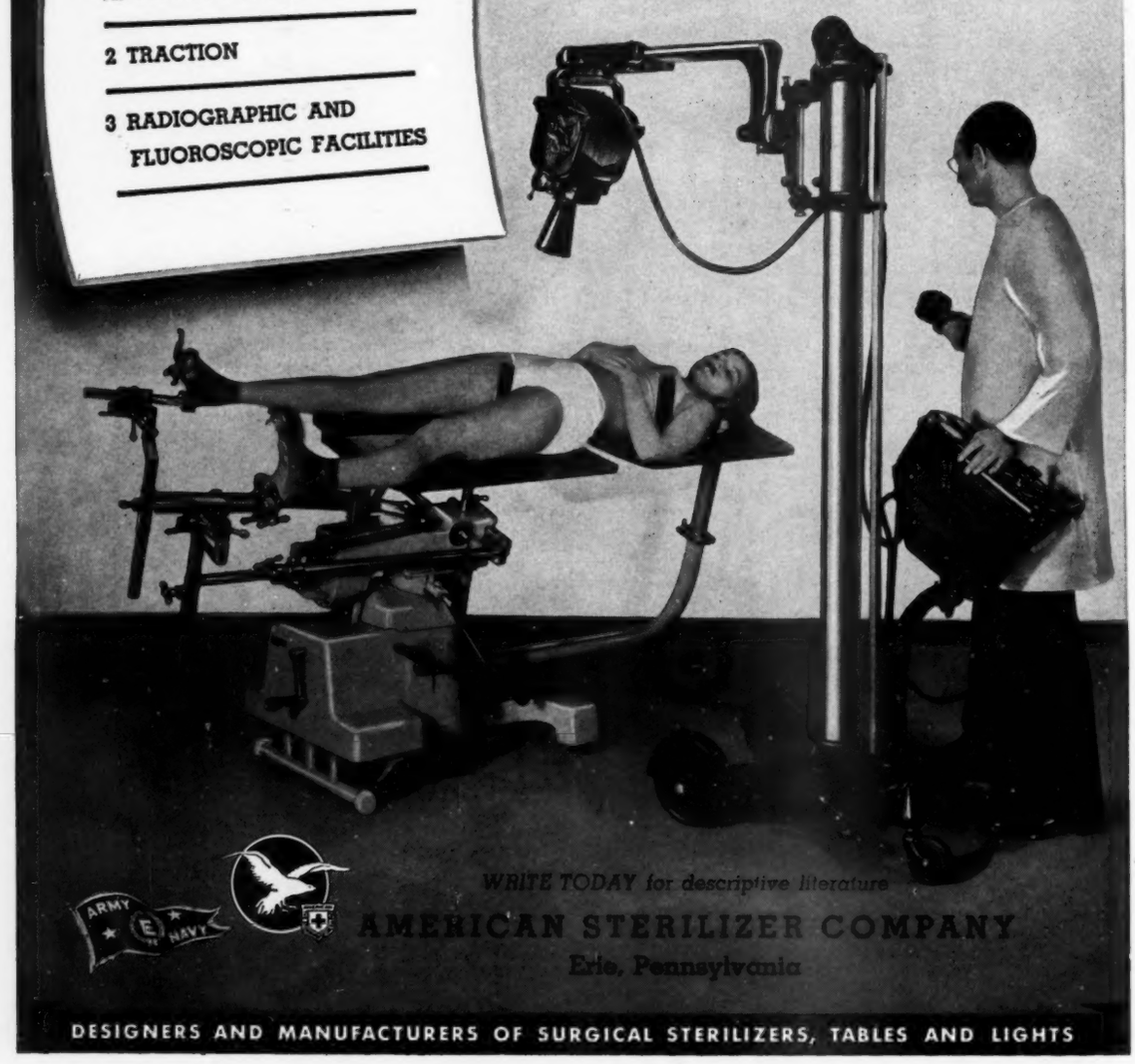

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Designed by T. R. Hannon, M.D., Baylor Medical College, Houston, Texas

Hannon Endometrial Biopsy Curette

For securing endometrial and cervical scrapings for microscopic study. Stainless Steel. Sklar Catalog No. S-5810

Designed by H. Thoms, M.D., Yale University School of Medicine, New Haven, Conn.

Thoms Uterine Tissue Grasping Forceps

New instrument to be used either as tenaculum, or for grasping tissue to be removed by knife, scissors or biopsy instrument. Jaws have 6 x 7 teeth. Stainless Steel. Sklar Catalog No. S-6502½

Designed by H. Thoms, M.D., Yale University School of Medicine, New Haven, Conn.

Thoms Modified Gaylor Specimen Forceps

Telescoping edges of grasping cups give shear action to cutting edges, facilitating procurement of cervical specimen for biopsy. Stainless Steel Sklar Catalog No. S-6561

Gelhorn Uterine Biopsy Punch

Spiked grasping cup, with positive shearing action of telescoping cutting edges, assures easy removal of uterine specimen for diagnostic examination. Stainless Steel Sklar Catalog No. S-6567½

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WRITE FOR REPRINTS AND DESCRIPTIVE LITERATURE

"Talc is a Dangerous Agent in its present use as a Surgical Glove Lubricant"[1]

SAFE SUBSTITUTE NOW AVAILABLE AT COST OF ONLY 2¢ PER OPERATION

Postoperative adhesions caused by glove powder have long been a serious concern of surgeons and operating room assistants.

All published studies agree that talc as a glove lubricant is unsafe. Animal experiments have shown the dangerous complications that follow talc implantation.

* * *

EFFECTS IN TISSUE

Talc consists chiefly of magnesium silicate. It causes granulomatous reactions in tissue, resulting in intra-abdominal adhesions, persistent sinus formation, or nodules in the wound.

* * *

"Implantation of glove powder may occur from unwashed gloves, perforations in gloves, spill on to sponges, instruments, and suture material, and by the air-borne route."[1]

* * *

SERIOUS COMPLICATIONS

"The frequency of such contamination is attested by the increasing number of case reports of serious complications due to talc. Animal experiments show that the granulomatous reaction can be regularly produced in the peritoneum, pleura, pericardium, muscle, joint, nerve and tendon."[1]

FOREIGN BODY REACTION

German[2,3] found intra-abdominal granulomata which he proved came from foreign body reaction to talc in 40 out of 50 unselected patients subjected to a second laparotomy.

* * *

Seelig[4,5] repeatedly demonstrated the danger of talc in mice, which are notably resistant to the production of adhesions, by injecting 2cc. of a 5% saline suspension of the powder intraperitoneally, and has stated that "the average surgeon cannot possibly perform this experiment and ever afterward face talcum powder with equanimity."

* * *

REPLACEMENT

As a replacement for talc, a wholly safe and efficient dusting powder is now available. This new powder, called Bio-Sorb, is a mixture of amylose and amylopectin, derived from corn starch, with a small amount of magnesium oxide added. It is treated physically and chemically to assure good lubrication after sterilizing.

* * *

COMPATIBLE WITH TISSUE

Bio-Sorb is compatible with body tissues and is rapidly absorbed. It does not injure rubber gloves. It fits regular O.R. technics. Costs less than 2 cents per operation. Bio-Sorb has been used over two years in several hundred hospitals. Complete literature mailed on request.

* * *

SAFETY CONFIRMED

The findings of Lee and Lehman[6] that Bio-Sorb is safe have been confirmed by Lindenmuth[7] and MacQuiddy.[8] Postlethwait et al[1] concluded that "talc is a dangerous agent in its present use as a surgical glove lubricant," and stated that "a modified starch powder (Bio-Sorb) which is absorbed with little or no reaction is again suggested as a satisfactory substitute for talc."

* * *

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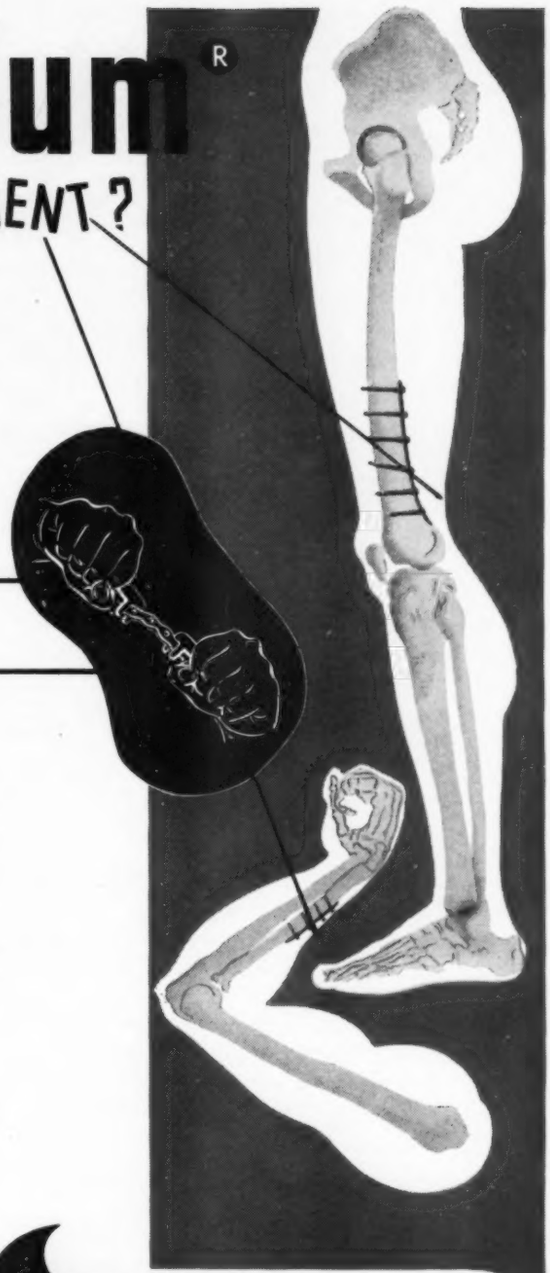

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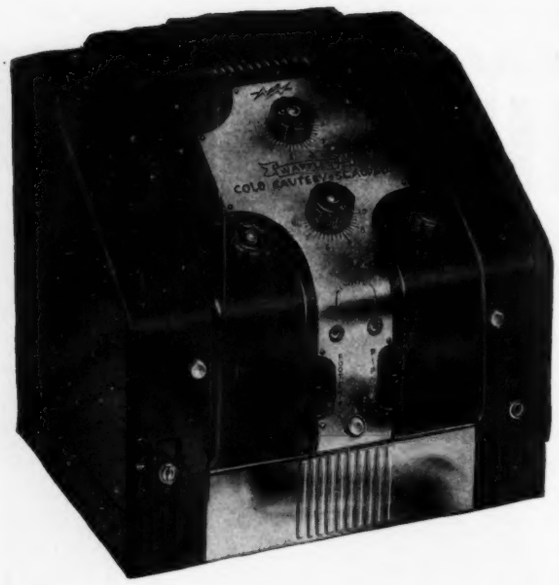

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THE WAPPLER COLD CAUTERY SCALPEL is a miniature high frequency apparatus which provides a high frequency current that can be utilized both for cutting and coagulation. The name "Cold Cautery" was selected to describe the effect of the current when applied to tissue because the electrode itself is cold, while the hot point, or thermal cautery, severs tissue by a searing contact of a heated metal wire electrode. The thermal or hot point cautery has certain limitations for operative work, such as excessive tissue destruction by radiation of heat, which in turn creates severe scar formation.

The Wappler Cold Cautery Scalpel being a high frequency apparatus, provides cutting and coagulating current which may be precisely controlled in intensity.

SPECIFICATIONS

MODEL C-450	MODEL C-450A	MODEL C-450B
is for operation on 110V. A.C. 50-60 cycles.	is for operation on 220V. A.C. 50-60 cycles.	is for operation on 110V. A.C. 25 cycles.

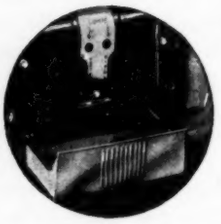
A footswitch and vacuum tubes are furnished with each model.

Write for Literature

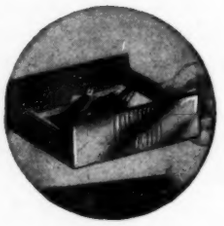
which completely describes various sets of electrodes and accessory instruments.

Note these Convenience Features

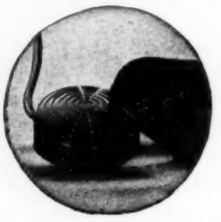
Conducting cords leading to the active and indifferent electrodes are housed within the case. To return the cords to their original position, pressure on the button above them instantly rewinds the cord.



The drawer and contents are automatically ejected from the case upon pressure on a button located directly above the drawer.



The cord connector of the shock-proof footswitch is plugged into the outlet marked "Footswitch." Bipolar electrodes, handle and cord are plugged into the receptacle marked "Bipolar."



Two outlets marked "Light" in center of the panel provide a means of supplying diagnostic light source. Conducting cords may be immersed in sterilizing solution in tray.

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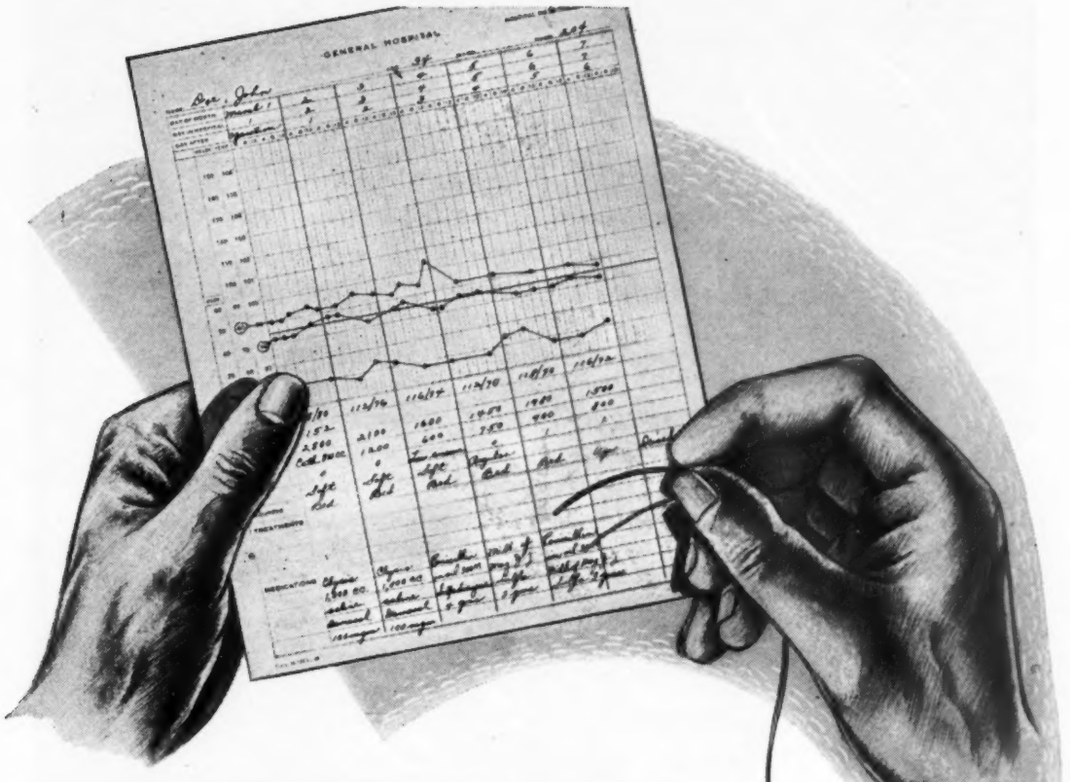

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To help avoid post-op fever due to suture chemicals and protein hydrolysis, specify CHAMPION Silk Sutures. Gudebrod Bros. Silk Co., 225 W. 34th St., New York 1.

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afford an excellent example as they are built up to a quality —not down to a price. Although their initial cost is slightly more per dozen, a cost analysis over a given period will often reveal that their comparative cost is actually less per individual blade.

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greater ease of intestinal intubation... new improved technic

The Cantor Tube

Patent applied for

A neoprene bag-tipped, mercury weighted, single lumen tube which utilizes the physical properties of mercury to the fullest extent to obtain more positive intestinal intubation. Features include—

- √ **Greater ease of intubation—first, ease of passage through the nares and nasopharynx; and second, ease of passage through the pylorus. Of 100 cases, 96 % were successfully intubated.**
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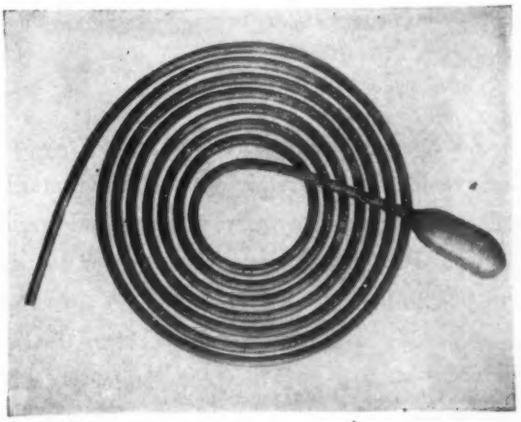

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Literature on request.

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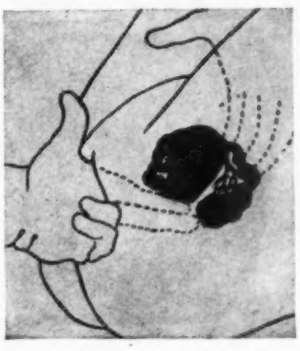
suspected . . . . .



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Adequate Breakfast

AND FATIGUE DURING THE PRE-NOON HOUR

That the daily eating of adequate breakfasts lessens neuromuscular tremor during the pre-noon hour was recently shown in physiologic studies* conducted at the Departments of Physiology and Nutrition of a prominent medical college. As a direct consequence of the better nutritional state induced by improved breakfast habits, involuntary neuromuscular tremor is less during the last morning hour when 800 or 400 calorie breakfasts are the daily routine than when breakfasts are regularly omitted or coffee only constitutes breakfast.

Six young women graduate students were the experimental subjects in this carefully controlled scientific investigation. For permitting adequate physiologic adjustments to the four breakfast practices (800 calories, 400 calories, coffee only, and no breakfast), each practice was followed for a three-week period. The data obtained in the 800 calorie breakfast period were used as the standard base of reference.

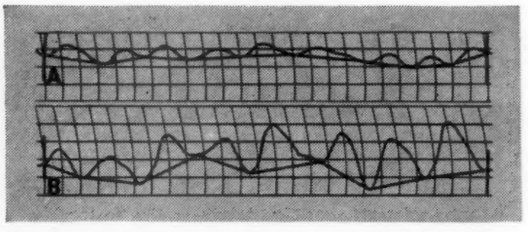
Using specifically designed apparatus, the investigators determined the pattern of amplitude and rate of involuntary muscle tremor of the unsupported outstretched arm both before and after strenuous exercise. Measurements were made during pre-noon hours of the experimental periods.

Conclusions derived from this practically significant study follow:

1. When no breakfast was the morning practice, the magnitude of muscle tremor substantially *increased*.
2. Habituation to coffee only for breakfast induced a similar *increase* in magnitude of muscle tremor.
3. Habituation to the 400 calorie breakfast after the coffee-only period markedly *decreased* the magnitude of muscle tremor; the tremor magnitude status tended to return to the status of the 800 calorie breakfast period.

The conditions of the study did not permit a direct comparison of the effects of the 800 and 400 calorie breakfasts on muscle tremor.

Health and nutrition authorities have long proclaimed the importance of daily adequate breakfasts in the promotion of good nutritional health. The results of this scientific study give direct experimental support to the soundness of such dictum.



Neuromuscular Tremor. Record of a normal tremor (A), and (B) exaggerated tremor. Subjects who are accustomed to eating breakfast have an exaggerated tremor when they suddenly begin to omit breakfast.

The presence of this seal indicates that all nutritional statements herein have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

*Reprint of the research study and findings will be sent on request.

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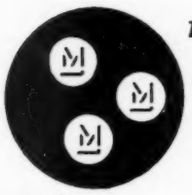

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DOSAGE: Initially, 2 mg. to 2.5 mg. (1 to 1.25 cc.) intravenously. Thereafter, 0.5 mg. to 1 mg. (0.25 to 0.5 cc.) at 10 to 30-minute intervals if required.

PRECAUTIONS: In case of respiratory depression from overdosage, controlled artificial respiration is essential and adequate.

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Outside the Ivory Tower

SINCE the publication of Arnold Jackson's editorial on streamlining certain types of scientific papers, there have been repercussions (largely favorable) and many men have taken the trouble to offer their opinions on the subject. We quote from a few letters Dr. Jackson received from outstanding surgeons from all parts of the country:

"The comments you have made about streamlining medical papers, omitting time-consuming introductory remarks and extraneous historical background is well overdue. I am sure the point is well taken and I hope your editorial will be effective in accomplishing a good purpose."

"I have read with a great deal of interest 'Time to Streamline Medical Papers.' I fully agree with you that a great deal of space and paper is wasted as well as time lost in reading 'padding' of medical papers, and especially a lot of history in the beginning of each medical paper which the average reader is familiar with or doesn't care to read. But, looking at it from the standpoint of the young man who is just beginning to write—if he writes only his little bit it would be rather meager—so he has to go back and give a history of say, 'Hashimoto Struma' and then quote every one in the literature and finally add his personal experience. This has been accepted so long that I am afraid you will have a hard time making the profession break away from the custom. However, I do agree with you."

"I think it is a good idea if one has the facility or faculty of streamlining an article and making it interesting. Of course, there are many things that one might leave unsaid in any paper that he writes. He might just limit himself to discussing one phase of the subject, and make the article short and brief. I am strongly in favor of the paper being short and concise."

"I think that the successful writer of today must go over his paper many times in order to delete as many words as is consistent with his plan to convey what he has in mind. It seems quite useless to me to review the historical background every time one wishes to present a modification of some well established operation. Life is filled with too much opportunity to spend time reading shopworn material. I, for one, am with you one hundred per cent."

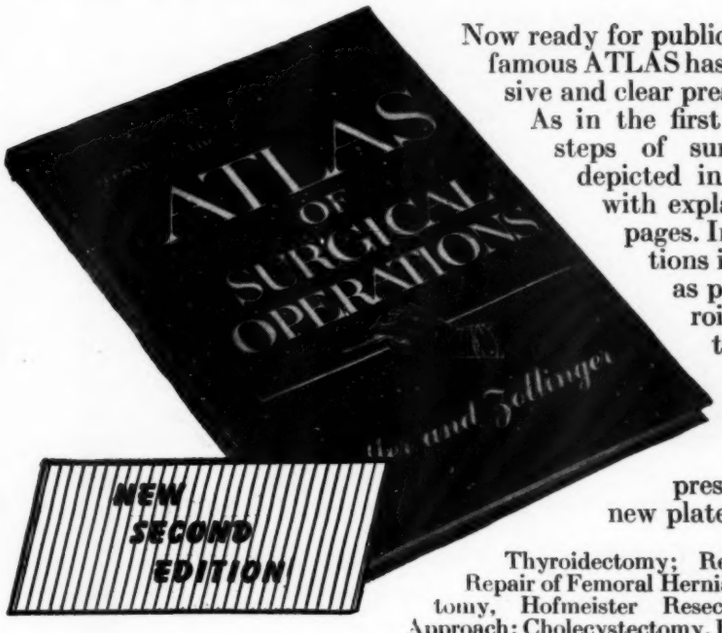
"In connection with your letter of July 19th re: the streamlining of medical papers, I have no doubt in the world that you are right in many respects. However, I think the tabloid idea of medical papers should definitely be restricted to certain types of journals and should not fall into general use. Briefly speaking, I am opposed to the idea in most instances as representing a discouragement to the more cultured minds of medicine but am wholly in favor of it covering certain papers of simple report type."

"I had this in mind some years ago, and believe thoroughly that it is a proper way to present the important points of the subject under discussion. After all unless one is presenting some very original piece of work, particularly work coming from the research laboratory where a great deal of data must be presented, I believe that much too much time is spent on chitter chatter."

"Really what one wants to know is what the author is driving at, what he is trying to prove, if anything, and what results he has had in the clinical management of his work. A long list of bibliographies and references is very valuable but it is not necessary to take up a large part of the paper itself with profound discussions of this aspect of the presentation. Of course, we know that every medical article cannot be presented in this so-called streamline fashion but I do believe that most of us would get more out of the magazines if we could eliminate the unnecessary embellishments and get down to the real essentials."

(*continued on page* 38)

ATLAS of SURGICAL OPERATIONS



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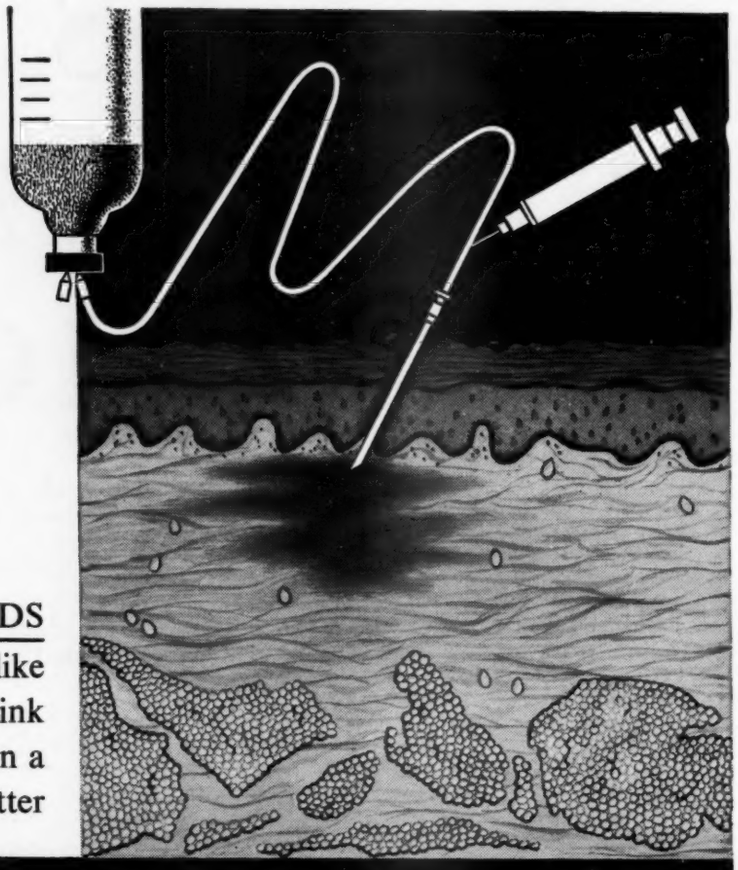

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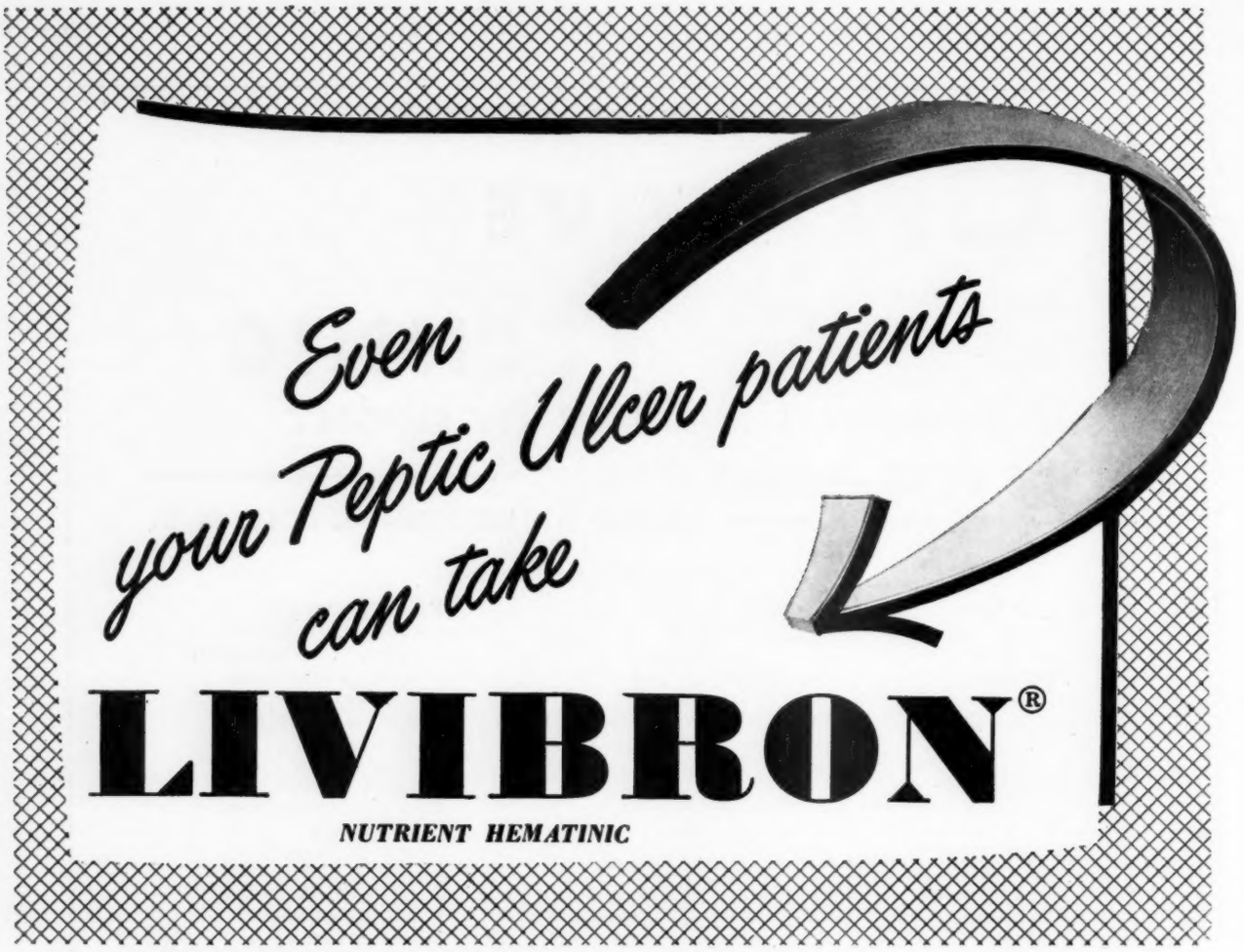

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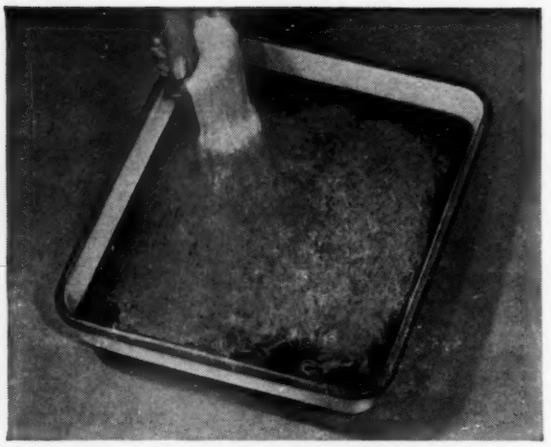

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Editorial

MENSTRUATION AND ACUTE APPENDICITIS

THE incidence of acute appendicitis during menstruation as seen in the operating room is quite low. The main factor leading to this low figure is the generally accepted view that pain just before or during menstruation is a normal condition and as such can be disregarded except in rare instances. Curtis[1] states that "definite pelvic pain is experienced by approximately 50% of city-dwelling American women; many are forced to go to bed for a day and a still larger number are considerably incapacitated." While this is a fairly safe line of reasoning as evidenced by the uncommonness of serious complications, acute appendicitis must always be kept in mind in acute abdominal pain. The writer has had two cases of acute suppurative appendicitis during active menstrual flow and one other such case has been seen at the Binghamton City Hospital during the last three years. Incidentally, these were the first personally seen in twenty years of active surgical practice.

An interesting viewpoint on appendicitis and the menstrual cycle is that presented by Hollosi.[2] He believes that as a result of the hormonal interrelationship in the mechanism of the menstrual flow, there is increased vascularity and congestion of not only the pelvic organs but also the contiguous structures including the appendix. In this process a peri-appendicitis is produced as demonstrated by hyperemia of the serosa, both gross and microscopic. He believes, too, that this predisposes to or rather prepares a fertile field for infection and the acute attack, and also that some cases of dysmenorrhea are coupled with a chronic appendicitis and that in these cases removal of the appendix will cure the dysmenorrhea. Hollosi emphasizes this relationship especially in the pelvic type of appendix. His analysis is based on careful clinical and pathologic study of 163 cases of appendicitis. In all but 15 per cent he believes that the hormonal reactions and menstrual changes played a part in the symptomatology. He stresses the need for care in operating for appendicitis at or about the menstrual period unless signs and symptoms indicate an irreversible condition since as a rule the symptoms are due to peri-appendicitis and operation is not necessary. He mentions the well known fact that any operative procedure carries with it some morbidity and even mortality. While there may be some question as to the acceptability of some of his opinions, the line of surgical treatment advocated is that practiced generally.

The following case reports bear upon this hypothesis:

[1] CURTIS, A. H. A Textbook of Gynecology. 5th ed. Philadelphia, 1946. W. B. Saunders Co.

[2] HOLLOSI, K. Appendicitis and menstruation. *Monatschr. f. Geburtsb. u. Gynäk.*, 106: 187, 1937.

An unmarried female, aged twenty-eight, was seen with a history of acute diffuse abdominal pain of twenty-four hours' duration. The pain had become localized in the right lower quadrant for three hours. She was nauseated and vomited the day previous but not on the day of admission. She had a normal bowel movement the previous day but none on the day of admission. She had had no previous similar attacks. A normal menstrual period began three days before (usual length five days) and she was still flowing. The flow was normal in all respects. During the previous three months there had been an increasing amount of dysmenorrhea.

Physical examination was negative except for acute localized rigidity and muscle spasm over the entire lower abdomen especially on the right. There was no tenderness on rectal examination when moving the cervix. Her temperature was 99½°F. orally. White blood cells were 14,500 with 90 per cent polymorphonuclears. Urinalysis was normal. A diagnosis of acute appendicitis was made and at operation the appendix was found bound down in the pelvis and completely surrounded by small bowel and cecum. It was gangrenous throughout and showed multiple points of perforation from which pus was oozing. It was removed in a routine manner and the abdomen closed without drainage. Convalescence was uneventful. The microscopic report showed acute suppurative appendicitis and peri-appendicitis with necrosis.

A white, unmarried female, aged forty-one, was admitted with a history of abdominal pain of twenty-four hours' duration beginning one hour after supper. There had been a "grinding" pain continuously since then. The pain had remained in the same area and was not accompanied by nausea or vomiting. Bowel movements were normal and she had no urinary distress, chills or fever. Her temperature was 100.4°F. The patient began menstruating two days previously which was one week early. Her previous period was also one week early and the one before that had been only eighteen days prior. She usually flowed five days and this present period was no different from any of the other periods and there had been no unusual discharge.

Physical examination was negative except for muscle spasm and rigidity over the lower right quadrant with marked rebound tenderness. The rectal examination showed tenderness on the right. The white blood count was 13,250 with 86 per cent polymorphonuclears. Urinalysis was negative. A diagnosis of acute appendicitis was made. At operation the appendix was found to be lying in the pelvis and adherent to the surrounding bowel. It was acutely inflamed and covered with fibrin. The microscopic diagnosis was acute suppurative appendicitis. Convalescence was uneventful.

A white, married woman, aged twenty-seven, was seen because of pain in the abdomen of twelve hours' duration. She complained of feeling chilly. There were no urinary or bowel disturbances. Her periods had been irregular recently, this period being two weeks overdue. She had been flowing for two days and the flow was more profuse but she was not hemorrhaging. She denied that she was pregnant as this delayed period had happened before. She was nauseated but had not vomited and there was no history of previous pregnancies.

Physical examination showed a well developed and nourished white female who looked ill. The abdomen was flat with muscle spasm throughout the lower abdomen and with marked rebound throughout but more so on the right. There was pain and marked tenderness over the right kidney; none on the left. Vaginal examination was unsatisfactory due to muscle spasm. The patient's temperature was 101°F; white blood count 14,600 with 88 per cent polymorphonuclears; red blood count 4,000,000 with 64 per cent hemoglobin. A differential diagnosis between appendicitis and pelvic inflammation or ectopic pregnancy could not be made. She was therefore put on penicillin and watched carefully. On the following morning her

temperature was down to normal. She continued to flow moderately. Pelvic examination was essentially the same as on the previous day. Forty-eight hours after admission her temperature rose to 101.6°F. and the blood count which had dropped down the following morning rose to 13,500 with 92 per cent polymorphonuclears. In view of the blood count persistent abdominal pain and rigidity, and the elevation of temperature, exploration was done. An acute suppurative condition of the appendix was found, with the appendix the size of a thumb and covered with fibrin. This extended into the pelvis and was completely walled off by bowel. It was removed in the routine manner and the abdomen closed without drainage. The microscopic report was acute suppurative appendicitis. Convalescence was uneventful except for a wound infection which cleared up quickly on being drained.

The diagnosis in this patient was obscured by the irregular menstrual history and the pain over the kidney. Expectant treatment was instituted because it was feared that the patient might have done something to bring on the flow despite her denials. The use of penicillin caused a temporary recession which led us to believe it was a pelvic inflammation. Surgery was decided upon only when it became evident that the patient was becoming worse.

A careful analysis of these three cases reveals some interesting points which in general seem to substantiate the ideas suggested by Hollosi.[2] The attack in each case was in a pelvic type of appendix. In the first case increasing dysmenorrhea was present. The second and third patients showed irregularity of the menstrual function although the flow was normal. In all three the menstrual flow had been present for from one to two days before a physician was called, suggesting that the congestion associated with the period might have played a part in making the process, once initiated, irreversible. All three patients showed an advanced type of disorder due to the fact that a physician was not called for from twelve to twenty-four hours after severe pain had started. Had there not been a menstrual flow there is no question but that these patients would have come to operation earlier since these were all city dwellers and had consulted physicians regularly for other complaints. The temperature was not over 101°F. but there was a marked leukocytosis with a high polymorphonuclear count as well as definite signs of an acute condition of the abdomen in all.

In the first and second patients the differential diagnosis was easy; the third patient presented a complicated picture due to her age and the severe pelvic signs. A differential diagnosis between infected ectopic pregnancy and pelvic inflammation could not be made positively. The writer has had one case of infected ectopic pregnancy previously reported[3] in which a diagnosis was made by cul-de-sac puncture. A review of cases at the Binghamton City Hospital at that time demonstrated that of sixty-two cases of ectopic pregnancy, twenty-three or 37.1 per cent had an elevation of temperature ranging from 99 to 102°F. The possibility of instrumentation always had to be considered in these patients. In our third patient previous sterility suggested the possibility of an ectopic pregnancy. The signs of infection were so severe, however, that cul-de-sac puncture was not done and the tendency was to consider it a probable pelvic inflammation.

The differential diagnosis between appendicitis and pelvic inflammation may be difficult and at times impossible. The presence of a purulent discharge from the urethra and the cervix plus the signs of diffuse pelvic disturbance could not be used as differential points in these cases because of the menstrual flow. The white count tended to differentiate a gonorrheal inflammation but corresponded in general to that expected in a streptococcic infection.

Pelvic appendicitis is difficult to diagnose

[3] SNEIERSON, H. Infected ectopic pregnancy. *M. Times*, 68: 107, 1940.

and sometimes may be diagnosed only after the condition has gone on to suppuration and abscess formation. The localization of right lower quadrant pain with muscle spasm may not be present; and if there is any vaginal discharge, pelvic peritonitis will undoubtedly be considered first. If the condition is seen sufficiently early and the process is limited to the right side, the diagnosis can be made with certainty. Graham[4] states that it may not be possible to differentiate the two in all cases.

Curtis[1] defines menstruation as a "bloody uterine discharge associated with necrosis of the uterine mucosa, normally recurring throughout the child-bearing period, except in the event of pregnancy, at relatively regular intervals of 3½ to 5 weeks, usually with a duration of from 2 to 5 days." It is evident, therefore, that a woman flows anywhere from one-tenth to one-eighth of the child-bearing period. In the ordinary course of events one would expect 10 per cent of operations for acute appendicitis to occur at this time in these patients. This evidently is not true, at least as far as operative reports are concerned, and yet immediate operation, as a rule, is practiced throughout this country whenever the diagnosis is made.

During 1946 through 1948 inclusive approximately 800 women patients were operated upon for appendicitis at the Binghamton City Hospital, of which only the three reported occurred during menstruation. This low incidence conflicts with the expected number suggested by Hollosi and suggests that menstruation is a coincidental finding only.

The presence of the pelvic type of appendix in each instance is important and bears emphasizing. We agree with Hollosi that given an acute attack in a pelvic appendix, the presence of acute congestion of the pelvic organs during menstruation will aggravate the inflammatory changes and tend to make them irreversible.

HYMAN SNEIERSON, M.D.

[4] GRAHAM, E. Surgical Diagnosis. Philadelphia, 1930. W. B. Saunders Co.

Original Articles

SURGERY FOR THE PREVENTION OF PULMONARY EMBOLISM*

HARWELL WILSON, M.D.
Memphis, Tennessee

PULMONARY embolism resulting in sudden death may now be prevented in many patients who in previous years were destined to succumb to this unfortunate condition without any rational therapy. For a long time it was believed that the hazard of death from pulmonary embolism was one which of necessity had to be borne by the patient who underwent major surgery. Surgeons and internists usually believed that little could be done to reduce the possibility of this complication. In recent years this attitude has been replaced by a widespread interest in seeking to diagnose thrombotic disease when it first develops and by appropriate methods of treatment to prevent the complication of pulmonary embolism. The current attitude toward the treatment of this condition and the lives saved as a result of this newer concept have resulted from a better understanding of the underlying pathologic conditions which cause the development of thrombi in the venous system.

In former years pulmonary embolism was usually considered a complication of surgery. It is now generally recognized that many patients who have never undergone surgery are at times troubled with venous thromboembolic disease and that these patients may suffer from a fatal attack of pulmonary embolism. Internists now correctly attribute certain chest complications as being the result of pulmonary emboli in bedridden patients who have undergone surgery. Attention is also being called to the presence of the early signs of venous thrombosis in the extremities. Adequate therapy saves many patients from the unfortunate outcome which in previous years occurred.

The majority of venous clots have their beginning in the deep veins of the lower leg and foot.[1–4] The thrombosis which begins in the plantar veins or in the deep veins of the leg may gradually extend to higher levels by direct propagation. In other instances such a clot may be dislodged before extensive propagation has taken place. In such instances fatal pulmonary embolism may occur and at autopsy the origin of the fatal embolus will not be found unless the veins of the lower leg are examined.

Thrombotic venous disease is usually divided into two types, phlebothrombosis and thrombophlebitis. Phlebothrombosis, a term which Ochsner and DeBakey popularized and which is referred to by Homans as the quiet bland type of intravascular clotting, is more likely to be followed by pulmonary embolism than is thrombophlebitis.[5] In my opinion it is rational to believe that phlebothrombosis and thrombophlebitis are in reality extreme variations of the same general process.[6] In thrombophlebitis there is a definite inflammatory reaction present in the wall of the vein. This inflammatory reaction increases the probability of the clot becoming adherent to the vein wall; consequently pulmonary embolism is less likely to occur in patients with thrombophlebitis than in patients with phlebothrombosis. It is also

* From the Department of Surgery of the University of Tennessee, Memphis, Tenn.

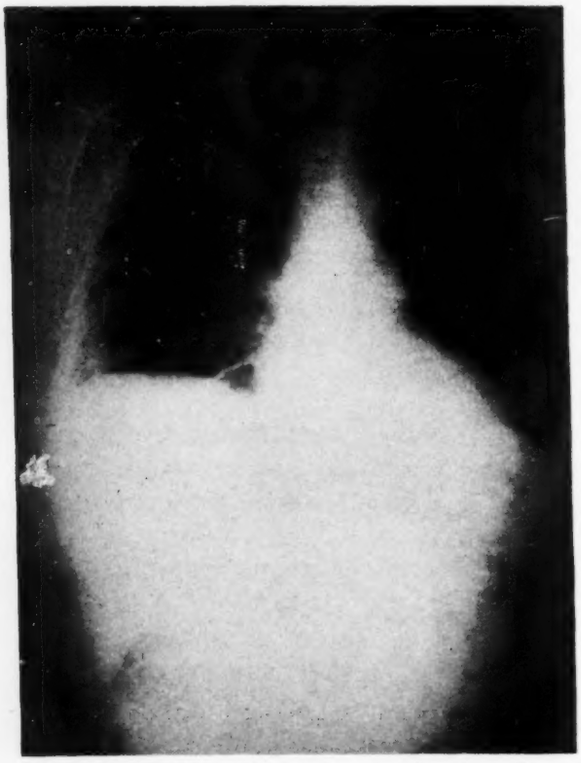

FIG. 1. Case 1; film of chest shows wedge-shaped area of increased density at lateral border of right lower lung field.

true that patients with thrombophlebitis have more systemic symptoms such as fever, leukocytosis, malaise and pain. Even though these two terms represent extreme variations of the same process, I believe that it is very useful to designate cases of thrombotic venous disease as belonging to one of the two types. The reason for this is readily apparent when one remembers that thrombophlebitis is infrequently followed by pulmonary embolism whereas phlebothrombosis or the bland type of thrombosis is not infrequently followed by pulmonary embolism. Because of the difference in the course of the conditions mentioned the treatment is decidedly different.

ETIOLOGY

Many factors influence the development of venous thrombosis. In some cases it is impossible to determine the exact etiology. Venous thrombosis in general is favored by anything which produces a slowing of the circulation, a change in the vessel wall or an increase in the coagulability of the blood. Perhaps the most important of these factors is that of the retardation of the circulation. It is readily apparent that any patient who is kept in bed for a period of time is more apt to have thrombi form in veins because of the retardation of the venous circulation which accompanies the lack of muscular effort.

The posture of the patient therefore becomes much more important than was formerly recognized. Pillows placed beneath the knees may make the patient much more comfortable; however, they certainly tend to cause stasis of the venous blood in the lower leg and therefore this comfortable posture may be dangerous. It should be remembered in practicing early ambulation that the patient who simply walks to a chair and sits in the chair for twenty or thirty minutes with the knees flexed and trunk flexed is not carrying out a procedure which will decrease the incidence of venous thrombosis and of secondary pulmonary embolism. Bandages which are applied too tightly may interfere with the venous return and may thereby contribute toward the formation of thrombosis in the deep veins.

Infection in or about a vein and trauma to a vein will tend to favor the development of thrombosis.

Dehydration favors intravascular clotting because of the fact that in such cases the coagulability of the blood is apt to be increased. The increase in the platelet count which usually follows major surgery also is a factor which favors the development of an increase in tendency toward intravascular clotting.

DIAGNOSIS OF VENOUS THROMBOTIC DISEASE

The diagnosis of thrombophlebitis is usually easy. Pain is produced by inflammatory reaction in the vein wall. This inflammation in the vein wall likewise produces an associated spasm of the arteries of the extremities and arterial spasm increases the pain. Fever is usually present. Examination reveals the presence of tenderness along the course of the vein and in many

instances a clot can be felt when the vein is palpated.

By contrast the patient who has phlebothrombosis may show few positive signs on may be a very slight cyanosis. Tenderness may be present over the soles of the feet and pressure over the calf muscles may likewise demonstrate tenderness.

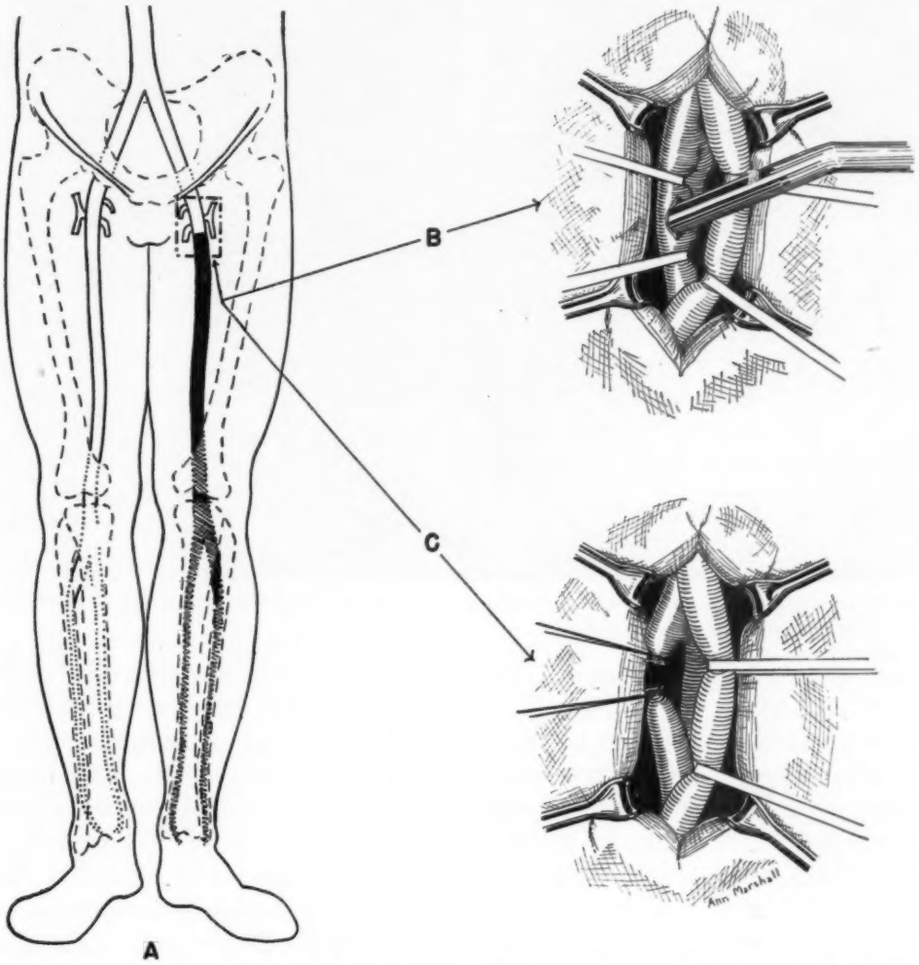

FIG. 2. Case 1. A, drawing illustrates extent of the venous clot extending up to just below the profunda branch of the femoral vein. B and C, insets demonstrate removal of soft thrombus with suction tube and ligation of vein.

examination. Usually there is a very slight increase in the pulse rate and likewise only a slight elevation of the temperature above normal. The patients with phlebothrombosis are apt to complain of some tenderness or discomfort in the calf of the leg. Dorsi flexion of the foot produces pain in the calf muscle group.

This finding which was described by Homans is usually referred to as Homans' sign. Inspection in such instances may reveal a very slight increase in the size of the veins of the affected extremity. There also

THERAPY FOR THROMBOPHLEBITIS

Elevation of the extremity without constriction below the knee is indicated. The local application of heat is beneficial. In the early course of the disease sympathetic nerve block with procaine helps to overcome the associated arterial spasm and thereby tends to decrease the pain. In some cases tetraethylammonium given intramuscularly to block the autonomic nerves is a helpful procedure. In such cases most surgeons now prefer to allow the patient to move the extremity as he desires; in fact,

FIG. 3. Case 11; anteroposterior and lateral views of chest demonstrating large pulmonary infarct secondary to embolus which originated in right femoral vein.

movement of the extremity is even encouraged in many instances.

In thrombophlebitis the clot is more likely to become adherent to the vein wall; however, it is true that in certain instances such a clot may break off and produce a fatal embolus.[7,8] In other instances showers of bacteria may be thrown off from an infected clot which is present in a patient with thrombophlebitis. Because of this in certain selected cases of thrombophlebitis vein ligation above the site of the thrombus is indicated. It is difficult to outline rigid rules regarding when venous ligation should be done in cases of thrombophlebitis. In general, however, we believe that a patient with thrombophlebitis in whom the process is spreading very rapidly should have a proximal vein ligation. It is also believed that patients who are having showers of bacterial emboli from an infected thrombus secondary to thrombophlebitis should have venous ligation.

THERAPY FOR PHLEBOTHROMBOSIS

Fatal pulmonary embolism may be prevented in many instances by the recognition in the early stages of venous thrombotic disease and by following such recognition with appropriate therapy. Appropriate vein ligation in the patient with phlebothrombosis in our opinion is the best method to prevent fatal pulmonary embolism. In certain instances it is possible to make a diagnosis of phlebothrombosis when the clot extends only to the knee. In such instances the superficial femoral vein is opened, divided and ligated below the level of the profunda vein. If the bland thrombus has extended to the level of the profunda or above and if it can be aspirated successfully so an adequate back flow of blood is obtained, one should still perform the venous ligation below the level of the profunda vein. When the superficial femoral vein can be ligated below the profunda, the patient is not apt to be troubled with postoperative edema of the extremity. On the other hand, in some instances the profunda itself is filled with clots and in such instances it will be necessary to ligate the common femoral vein above the profunda. The utilization of an elastic bandage for a period of several weeks to a few months

following operation is very beneficial in decreasing permanent edema of the extremity. It should be remembered that the edema which follows the treatment of such disease is associated with and, to a great extent, is dependent upon the amount of intravascular clotting which existed before the operation was done. It is common knowledge that patients who have had recurrent thrombophlebitis are apt to have chronic edema of the extremity. In many instances it is possible to aspirate a soft thrombus from the iliac vein through the opening in the superficial femoral vessel. In some other instances it is impossible to remove such a clot by this method. In such instances if the patient's general condition permits, we believe that it is safer and technically easier to ligate the vena cava above the bifurcation rather than to attempt a bilateral iliac ligation.[9,10]

FIG. 4. Case III; film reveals congestion of both lung bases and the presence of fluid in the costophrenic angles.

ANTICOAGULANT THERAPY

Heparin and Dicumarol have been used by many in the treatment of the condition being discussed.[11–17] It is certainly true that these agents decrease the coagulability of the blood. It is also true that neither heparin nor Dicumarol have any tendency to dissolve a thrombus which is already present in a vessel. These agents simply make propagation of such a clot less likely to occur and do not give any assurance that the clot which is already present will not break off and cause fatal embolism. We have treated a limited number of patients with anticoagulant therapy. However, we much prefer to treat such patients by appropriate vein ligation since we believe this procedure gives greater security against fatal pulmonary embolism and likewise it is less likely to be followed by untoward complications.

CASE REPORTS

CASE I. G. R. E., a white female, age sixty, was seen in consultation at the Willis C. Campbell Orthopedic Clinic on December 12, 1948. The patient had been in bed for three weeks while receiving treatment for a chronic back complaint. During this time the patient suffered a sudden attack of severe chest pain with associated hemoptysis. There was a definite sensation of impending doom. The past history revealed several attacks of thrombophlebitis in the right leg occurring over a period of several years. Examination of the chest revealed a friction rub near the base of the right lung. A chest x-ray demonstrated a wedged-shaped area of increased density in the right lung field characteristic of a pulmonary infarct. (Fig. 1.) Examination of the right lower extremity showed Homans' sign to be positive (pain in the calf resulting from dorsi flexion of the foot). There was a slight distention of the veins of the right foot.

Femoral vein exploration was first done on the right side. The vein was opened just below the site of the profunda branch. A large soft clot was found in the superficial femoral extending to a point just below the profunda. A portion of the thrombus approximately 4 inches long was removed with the suction tube. (Fig. 2.) A normal back bleeding occurred from above and the profunda did not appear to be involved. The vein was divided and transfixed at the point where it had been opened.

Because of the possibility of a silent thrombus in the left superficial femoral vein, the left side was opened, divided and ligated. No clot was found on the left side. Elastic bandages

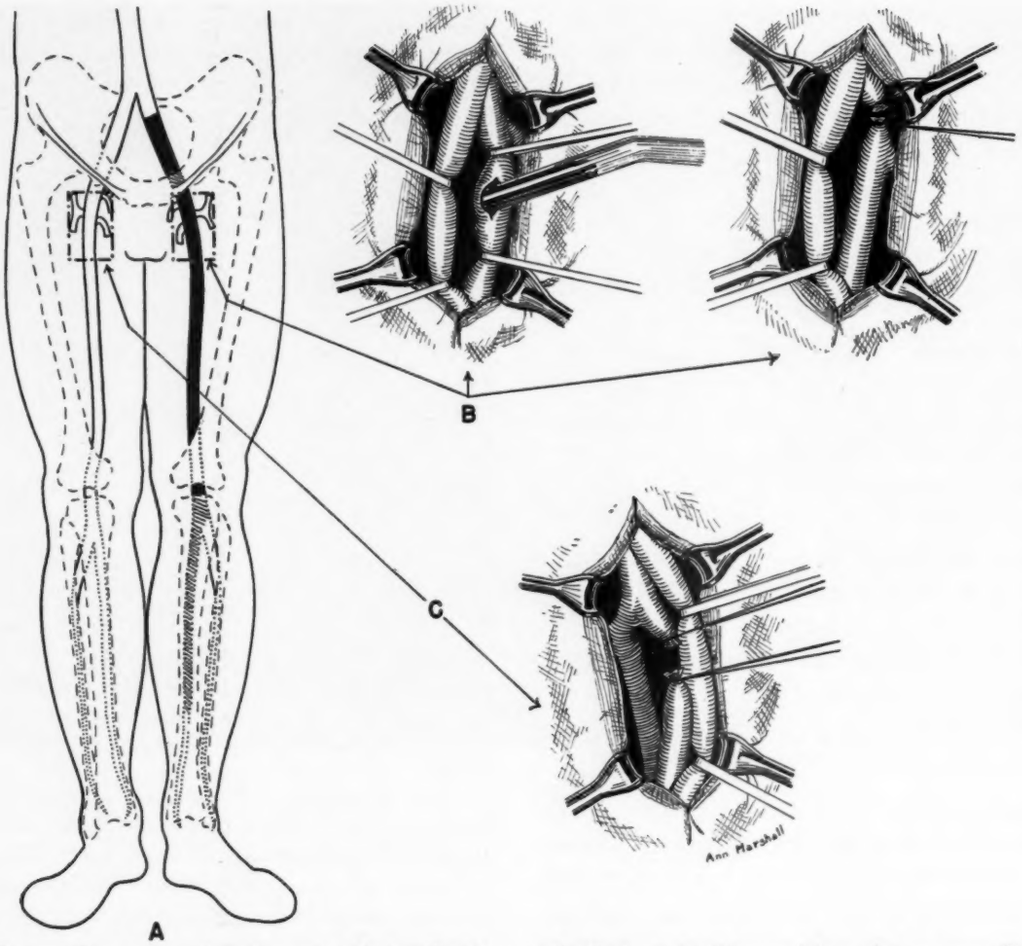

FIG. 5. Case III. A, thrombus extended well above profunda branch of femoral into the common iliac vein; B and C, clot removed by suction and vein divided above the profunda branch.

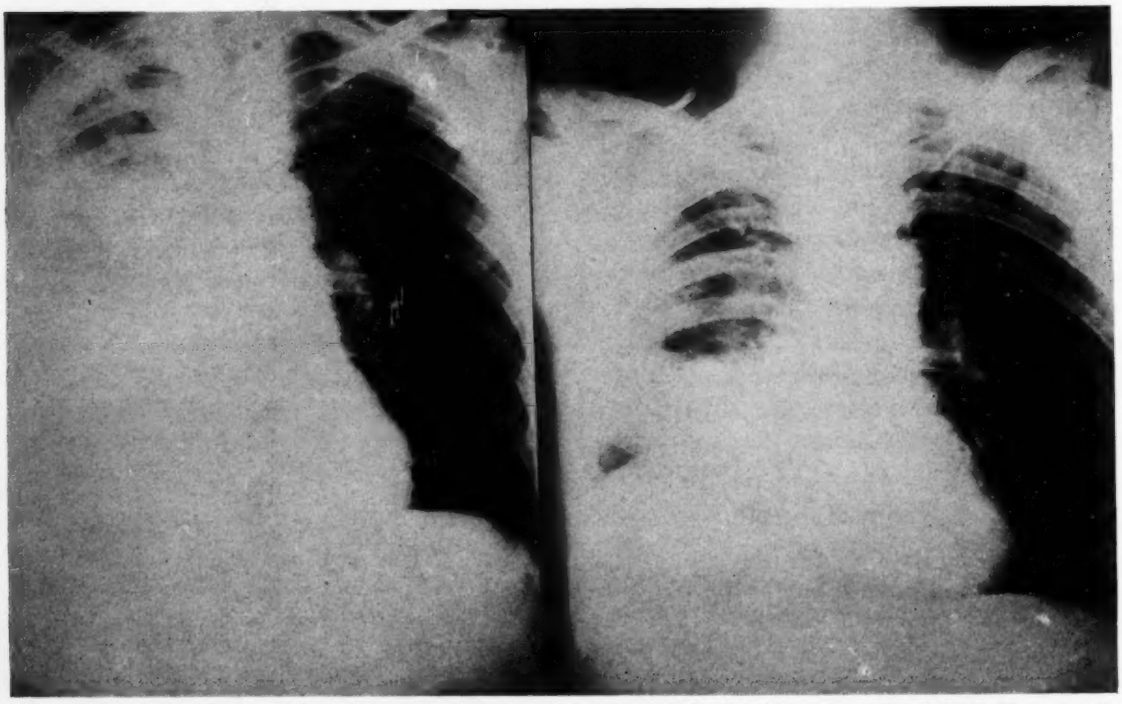

FIG. 6. Case IV; films made on admission to hospital before and after thoracentesis. Initial film reveals massive hydrothorax; film after the chest aspiration reveals massive infarct of right lung.

were used on the extremities for several weeks. There have been no recurrences of pulmonary infarction and no residual swelling of the extremities.

CASE II. W. H. C., a male, age thirty-five, entered the Baptist Memorial Hospital on the chest service of Dr. Duane Carr May 11, 1948, because of pain in the right chest, hemoptysis and fever. The history revealed that the patient had suffered from recurrent attacks of thrombophlebitis in the right leg over a period of years. Examination of the chest revealed extensive abnormal findings in the right side. A film demonstrated a large wedge-shaped lesion interpreted as a large pulmonary infarct. (Fig. 3.) There was tenderness to pressure over the right calf muscle and dorsi flexion of the right foot produced pain.

A thrombus was found in the right saphenous vein extending to a point 1 inch below the junction of the saphenous and femoral veins. The saphenous was divided above the thrombus. The superficial femoral vein was opened and divided below the profunda branch on both the right and left side. No thrombus was found in either femoral vein. There has been no further pulmonary difficulty. The right leg remained slightly swollen for a period of three months necessitating the use of elastic bandages.

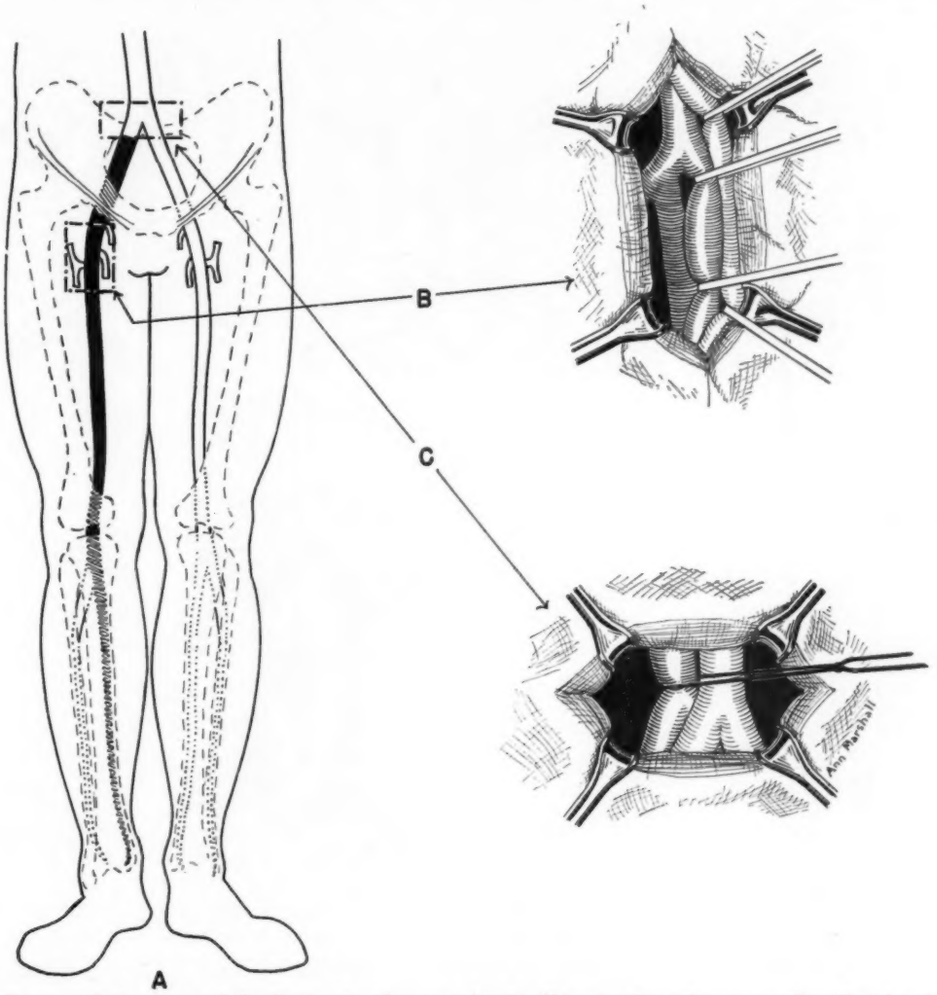

FIG. 7. Case IV. A, right femoral vein contained adherent thrombus; B and C, ligation of vena cava accomplished through transverse incision at level of umbilicus.

Comment. Pulmonary emboli occur more frequently in patients with phlebothrombosis and in those with frank thrombophlebitis. This case emphasizes that these conditions are probably only variations of the same process. Varicose saphenous veins are rarely the site of thrombi producing embolism but this case illustrates such an instance.

CASE III. J. M., a male, age forty-five, entered the hospital on the medical service of

Dr. Phil B. Bleecker, October 7, 1947. The patient had suffered from repeated bouts of chest pain with associated fever and cough. Chest examination revealed a friction rub over the left chest laterally and anteriorly. Films of the chest demonstrated congestion at both bases and a slight amount of fluid was seen in a period of years the patient had suffered from recurrent attacks of thrombophlebitis in the right leg. An extensive pleural effusion was found in the right side. After thoracentesis an area of increased density was found which was interpreted as a massive pulmonary infarct of the right lower lobe. (Fig. 6.)

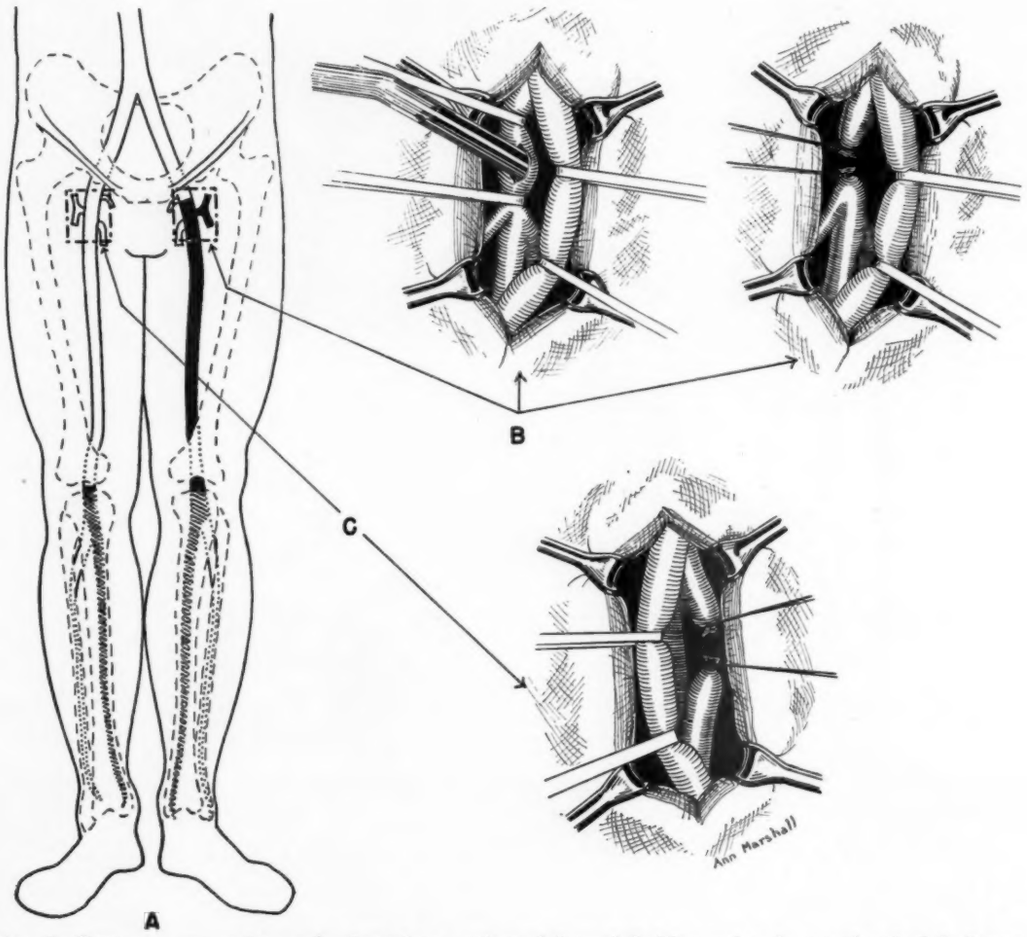

FIG. 8. Case V. A, B and C, soft thrombus aspirated from left iliac vein via opening in left femoral; profunda branch filled with thrombus; ligation of femoral vein above profunda branch.

the costophrenic angles. (Fig. 4.) Several days after admission to the hospital the patient developed signs of phlebothrombosis of the left leg. At operation a soft thrombus was aspirated from the left femoral vein. The profunda branch was found to be involved and the vein was divided above this junction. (Fig. 5.) No clot was found when the right vein was explored. There have been no further attacks of chest pain, fever or cough.

CASE IV. P. R., a white male, age forty-nine, entered the hospital October 18, 1947, on the chest service of Dr. Duane Carr. The chief complaint was that of dyspnea and fever. Over

At operation the right femoral vein was explored. It was found to be filled by a thrombus which could not be removed early. The thrombus extended well up into the right iliac vein. (Fig. 7.) The vena cava was exposed and ligated just above its bifurcation with a strip of umbilical tape. The superior limit of the thrombus was seen in the right iliac vein below its junction with the vena cava. Most of the extremity edema subsided after two months. After eight months there was only a very slight amount of swelling which was present in the right ankle.

Comment. This probably is an example of a bland thrombus being superimposed upon an old organized clot which originated from frank thrombophlebitis.

The left femoral vein was opened and immediately a soft clot 2 inches long extruded itself. With the suction tube a thrombus which appeared to be a cast of the left iliac vein was removed. The femoral vein was ligated above the profunda. The right femoral vein was explored and ligated below the profunda branch. (Fig. 8.) Convalescence was uneventful.

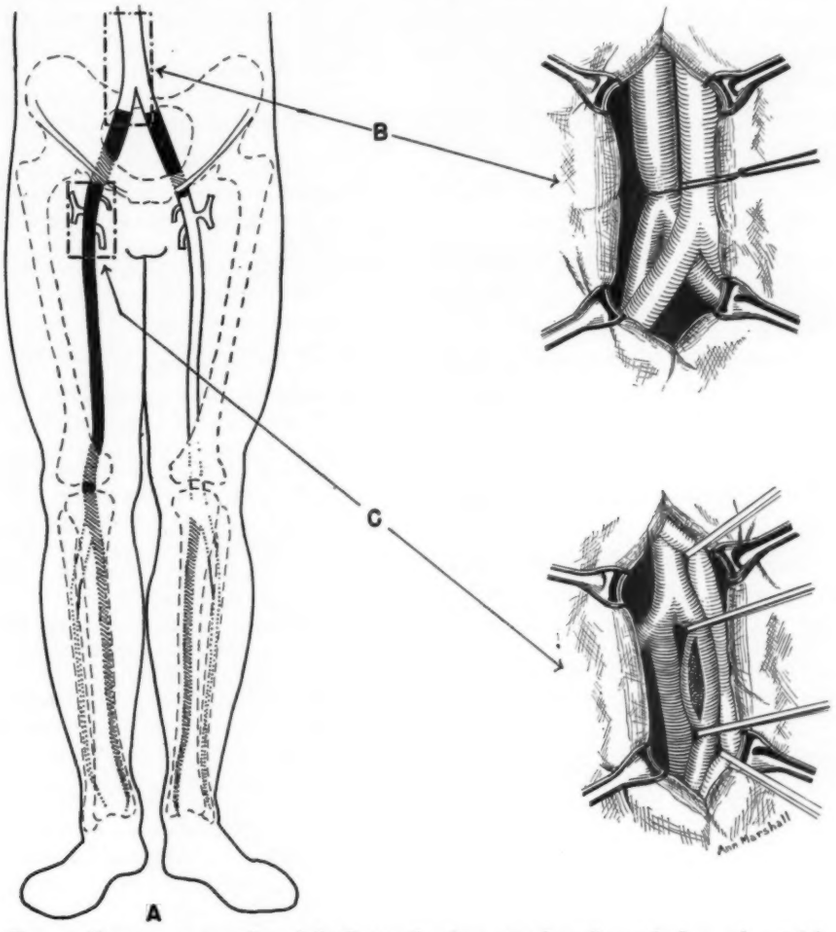

FIG. 9. Case VI. A, B and C, right femoral vein opened as shown in lower inset (C). Adherent thrombus could not be removed; longitudinal transabdominal incision used to expose vena cava; thrombi found in both common iliac veins; ligation of vena cava performed above bifurcation of vena cava.

CASE V. C. W. R., a white male, age sixty-five, was admitted to the hospital on January, 22, 1948, on the orthopedic service of Drs. Higley and Ray because of pain, swelling and tenderness of the left leg. Approximately three weeks prior to this admission patient had been struck by an automobile and had sustained a fracture of the right fibula and shoulder injury. On January 21, 1948, the patient noticed pain, swelling and tenderness of the left leg. One day later the tenderness and swelling extended into the left thigh. Homans' sign was positive. The left thigh was tender along the course of the left femoral vein. This appeared to be a rapidly progressive thrombotic process involving the left femoral vein.

CASE VI. W. L. B., a white male, age sixty-five, was admitted to the hospital November 29, 1947. On admission the patient complained of pain beneath the right lower ribs anteriorly. He had been hospitalized previously because of thrombotic venous disease of the right leg but had refused treatment. A diagnosis of phlebothrombosis of the right lower extremity was made.

At operation it was impossible to remove the firm clot from the right femoral vein. The thrombus obviously extended into the right

iliac vein. The abdomen was opened and the vena cava explored. Thrombi were found extending into both common iliac veins. The vena cava was ligated just above its bifurcation. (Fig. 9.) The postoperative course was stormy and it was necessary to do a secondary closure of the abdominal wound because of wound disruption. However, the patient eventually made a satisfactory recovery. Three months after operation there was very little swelling of the extremities.

SUMMARY AND CONCLUSIONS

1. Some of the etiologic and pathologic features of thromboembolic venous disease have been reviewed.

2. Phlebothrombosis and thrombophlebitis are believed to be extreme variations of the same abnormal process.

3. Fatal embolism is less likely to occur in frank thrombophlebitis than in phlebothrombosis.

4. Phlebothrombosis when definitely diagnosed is probably best treated by appropriate vein ligation.

5. Acute thrombophlebitis usually is best treated by sympathetic block, elevation of the extremity, motion without weight bearing and the use of heat in cases in which it makes the patient more comfortable.

6. Anticoagulant therapy expertly used will definitely decrease the incidence of pulmonary embolism. There are certain inherent dangers associated with use of this form of therapy.

7. Conscientious use of measures designed to prevent venous thrombosis will result in the saving of many lives.

8. Illustrative cases are cited which emphasize the variety of patients that may suffer from thromboembolic venous disease.

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PHLEBOTHROMBOSIS OF THE LOWER EXTREMITIES*

CRITICAL FACTORS IN EVALUATING THE SITES OF FEMORAL VEIN SECTION

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DEEP phlebothrombosis of the lower extremities continues to be a problem far reaching in its complications and sequelae. Its importance is readily indicated by the fact that fatal embolism following phlebothrombosis occurs in 3 to 6 per cent of cases.[1] Further, 11 to 18 per cent of patients who survive one pulmonary embolus experience a subsequent one which is fatal.[2,3] Chronic lymphedema is another serious problem not to be taken lightly. It is evident that the most desirable treatment is that which will result in a minimum of swelling, reduce morbidity and avoid mortality. In spite of the voluminous literature now listed on the subject some misunderstanding apparently still exists as to the indications for femoral vein section and especially the levels for section.

Among other things this paper is especially concerned with evaluating the sites of femoral vein section. In a discussion of the factors concerned a consideration of the physical effects of ligation at different levels is important. Equally important moreover is an analysis and review of many problems peculiar to thromboembolic disease. Based on the aforementioned an interpretation of management should comprehend a consideration of the following problems and factors: (1) pathogenesis of thrombosis in the lower extremities; (2) the importance of adequate physical examination in the diagnosis of origin and progression of the thrombosis; (3) evaluation of the end results of femoral section at different levels as concerns postoperative edema and sequelae, namely, phlebitic ulcer; (4) postoperative morbidity and mortality; (5) results of femoral section at different levels with and without anticoagulants; (6) femoral section in acute femoro-iliac thrombophlebitis and its relation to embolization; (7) the incidence of pulmonary infarction after section at different levels; (8) femoral section when contraindications to anticoagulants exist, namely, bleeding tendency, arteriosclerosis, hepatic disease, hypertension, recent gastrointestinal bleeding, prolonged initial prothrombin time and hyperthyroidism; (9) the status of venography in determining level of femoral vein section; and (10) the role and effectiveness of prophylaxis in thromboembolism.

It is not our purpose at this time to consider the controversy of ligation versus anticoagulant treatment. It is believed that a proper evaluation of the different types of treatment will relegate them to their proper sphere regardless of the enthusiasm of their advocates. We do not believe that anticoagulant therapy and ligation should be considered separately as anticoagulants may be used at times whether operation is carried out or not; this is our practice.

Present mature judgment now tends toward the conclusion that both surgical and medical treatment have comparably reduced the fatalities due to initial and subsequent pulmonary emboli. Although admittedly not the complete solution to the problem, either method is undoubtedly preferable to the "do nothing" or "expectant" school of treatment. One method or the other, or both, should be used in every patient if that individual is to receive treat-

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ment commensurate with present day medical knowledge.

It is probable that we know the proper therapeutic measures but in the light of our present knowledge are still unable to select critically the right method for the right patient.

It is now well established and generally recognized that thrombosis of the lower extremities most often begins in the plantar and calf veins, less frequently in the veins of the abductor muscles and rarely in the femoral and lower iliac veins as was previously supposed.[4,5] Hunter et al. and Frykholm,[6] among others, have graphically demonstrated this in their pathologic studies. While the aforementioned veins are the principal sites of origins of thrombi, it is well to remember that they can originate in other primary sites.

As one understands the course that the disease may follow the rationale for the different types of vein interruption becomes clear. Homans[7] has described the course that phlebothrombosis in the lower extremities may take as follows: (1) The thrombus may heal without ever progressing upward above the knee or causing pulmonary embolism. (2) It might develop into a femoro-iliac thrombosis (phlegmasia alba dolens) in which case it was very unlikely to cause pulmonary embolism? (3) It might form a soft propagating thrombus seriously threatening pulmonary embolism.

Based on a study of forty-two cases it is believed that the different stages of phlebothrombosis can be divided into five stages as an aid to clinical management as follows:

Stage I. Here the thrombus is present most frequently in the muscles of the calves and less commonly in the plantar and adductor muscles and may have progressed up to but not into the popliteal veins. *Stage* II. The thrombosis has progressed into the popliteal and lower femoral veins. At this point it is generally found as a propagating floating mass which is not adherent to or obstructing the femoral veins. *Stage* III. Here the thrombus has further progressed as a loose, propagating mass which may only partially obstruct the femoral vein and may or may not be adherent to it. It has generally reached the level of the common femoral vein and there may or may not be concomitant clot present in the profundus. *Stage* IV. The process has progressed so that the thrombus extends well up into the iliac vein. At this point it may be adherent to the intimal surface of the vein and is generally non-obstructing. The proximal end of the thrombus may be detached easily. An associated thrombosis may or may not be present in the deep femoral system. *Stage* V. Beyond this point the clot becomes strongly adherent to the entire femoral vein and now fully obstructs it and the internal iliac vein. An inflammatory reaction develops. This process is accompanied by lymphangitis and the end result is an acute femoro-iliac thrombophlebitis or so-called phlegmasia alba dolens.

Unquestionably, emboli can occur during any one of the aforementioned stages. In Stage I if an embolus is detached, it generally will be very small because of the small caliber of the veins encountered in the muscles involved. There may be frequent showers of small emboli, most often non-fatal. In Stage II there is a greater threat of pulmonary embolus. Here inasmuch as the thrombus has reached the larger-sized vessels, the popliteal and the lower femoral, a much larger-sized embolus can be detached. This embolus, of course, may or may not be fatal. In Stages III and IV pulmonary embolism is seriously threatened at all times. Here there is a long, loosely attached, propagating thrombus which can detach at any time an embolus large enough to be instantly fatal. This is probably the most dangerous stage in the progression of the thrombosis. In Stage V, or femoro-iliac thrombophlebitis, embolism occurs infrequently. The reason for this is easily understood inasmuch as there is an intense inflammatory reaction associated with the process of clotting. Here the thrombus is usually quite adherent to the intimal wall. However, contrary

to opinion, one may not be completely assured that embolism cannot occur when the process has developed into a true milk-leg for emboli can be and not infrequently are detached from such a thrombus. Hence, while the frequency of detached emboli in Stage v is undoubtedly less than in the preceding stages, it is definitely a factor to be reckoned with in treatment.

This origin and propagation by stages of a thrombus of the lower extremities to a full blown femoro-iliac thrombophlebitis has its evidence in the following facts. First, Bauer[8] has shown and traced by venographic studies the development of a full fledged obstructive phlegmasia alba dolens from its source in the deep veins of the legs. Second, at times a history of pulmonary infarction can be secured indicating that a soft, non-obstructive thrombosis has preceded by some time the appearance of the typical edema and discomfort of a femoro-iliac thrombophlebitis. Third, there are observations such as that cited by Conner[9] based on experiences with typhoid fever of very suggestive early signs in the form of pain and tenderness in the toes, feet and calves before the unmistakable swelling of phlebitis becomes apparent. Finally, the graphic studies of Hunter and his associates show the presence of clot at different levels at autopsy and are additional evidence for the origin and progression of the thrombus as above described. Bauer and others have estimated that about 90 per cent of iliofemoral thrombophlebitis is of such origin and about 10 per cent begin elsewhere in the groin or pelvis.

The essential difference between phlegmasia alba dolens and an advanced phlebothrombosis lies in the unexplained inflammatory action about the artery and vein in the femoral and iliac regions of the thrombus. Only when the occluded vein is completely obstructed by a solid thrombus does this reaction set in giving rise to the edematous limb often painful, usually marked by tenderness over the affected vessels, together with some perivascular inflammatory thickening in the groin. The reaction may be minimal or take the form of an acute non-suppurative exudate. The exudate involves the nearby nervous and lymphatic structures as well as the artery and vein.[10] This certainly offers an explanation of the occasional viscious local spasmodic constriction of the artery and the irritating impulses which appear to travel centrally from the region involved, calling forth reflexly, by way of the sympathetic nervous system, the peripheral vasoconstrictions which are to be recognized as a major cause for the edema and discomfort of acute femoro-iliac thrombophlebitis.

Based on this description of the origin and propagation of a thrombus in the lower extremities, we believe that one may with a reasonable degree of accuracy diagnose the level of the thrombosis based on clinical signs and findings. The physical signs and findings in the different stages will now be described together with the underlying basis for the appearance of some of these signs. It is with these factors in mind that one can proceed to manage adequately the various cases of phlebothrombosis which he encounters.

At the onset of Stage 1 (phlebothrombosis of the lower extremities) it is quite likely that there will be no symptoms whatever. The only way of discovering an early phlebothrombosis in the leg is by routine palpation of the calf, adductor muscles and the plantar aspect of the foot to ascertain tenderness. In our series the very first complaint offered by the patient was that of pain which occurred in 40 per cent of the cases. In a group of 200 cases studied Kleinsasser[11] reported pain as being the first symptom in 34.8 per cent of the cases. Other early findings that may occur in this stage of phlebothrombosis are an elevation of temperature and tachycardia which will be seen in a small per cent of cases. At this stage a positive Homans' sign can generally be elicited. We have observed that if one routinely palpates the calves of postoperative patients, tenderness will often be elicited before a Homans' sign appears. When Homans' sign appears, the process

is reasonably well along and phlebothrombosis is well established. Pulmonary embolism can and does occur as an initial finding in early phlebothrombosis when there are few or no leg symptoms. As a matter of fact, a certain percentage of patients will be admitted to the hospital with findings of pulmonary embolism. Examination will disclose the presence of phlebothrombosis of the lower extremities. Pulmonary embolus under these circumstances will generally be of the sub-lethal variety because of the small size of the vessels in which the clot originated. In this stage of phlebothrombosis the single most important finding is calf tenderness. This can be elicited very early in the course of the disease by repeated examination of the probable source of origin of the thrombi. If this is done, phlebothrombosis will be diagnosed at the stage which may be termed the "golden period" of treatment.

In Stage II with an advancing tibial phlebothrombosis, the thrombus may have reached the level of the popliteal or lower femoral vein. The findings usually will be a repetition of those of the previous stage and probably the initial complaint of the patient will be pain in the calf. Here the process is well established and it has progressed beyond the stage of original tenderness elicited by calf palpation. Elevation of temperature, tachycardia and sedimentation rate elevation are frequently observed. A positive Homans' sign is usually present. As in the earlier stage, pulmonary infarction not infrequently may be the presenting complaint. Usually there are no evidences of obstructive phenomena. There is a good probability of a fair-sized embolus being detached. The incidence of pulmonary infarction is greater here than in the previous stage. In addition there may or may not be a few dilated leg veins. Similarly there may or may not be mild cyanosis of the lower extremity in the dependent position. Cyanosis usually is not evident in the recumbent position.

In Stages III and IV all the previous findings will be apparent. In addition dilated veins will be especially noted, particularly on the anterior aspect of the leg. This is due to the progression of the thrombus with partial occlusion of the main deep vein and resultant compensatory dilatation of the superficial leg veins as a collateral circulation. Pratt[12] has called attention to certain dilated veins that he has observed repeatedly. He states this consists of the dilatation of three small superficial veins directly over the tibia, running into one medial branch in phlebothrombosis. He believes that with occlusion of the main vein in the popliteal space these small veins dilate because they are the closest collateral vessels, and this sign has been so constant in his experience that he now considers it of definite diagnostic value. This in general is in agreement with our observations; and when dilated veins are noted as described heretofore, we believe that they have great significance. Under these circumstances a thrombosis probably exists which is well along in the course of the femoral vein which is propagating, is loosely attached and is seriously threatening embolism. This is a very dangerous state of phlebothrombosis. The next sign usually found in this stage is edema of the lower extremities, particularly on dependency. The explanation for this is obvious for as the clot advances a greater degree of occlusion of the femoral vessel occurs with the consequent inadequate circulation and resultant venostasis and edema. As the clot progresses the edema becomes more advanced. On the basis of grading of one to four in this stage of phlebothrombosis, the degree of edema will generally be one or two plus. In our series of cases edema was noted in this stage of phlebothrombosis in 87 per cent of the cases. Cyanosis of the lower extremities, particularly on assuming the erect position, is usually more evident. The pathogenesis or origin of the cyanosis is similar to that for the previous finding. In a small percentage of cases at this stage (8 per cent in our group) there may be coldness of the extremities due to associated arteriospasm and with it sweating,

tingling of the legs, rarely numbness and redness. Occasionally in this stage thrombosed superficial varicosities will be noted in the leg which are occasionally a heralding sign of associated deep phlebothrombosis. These are usually inflamed and are always tender to touch. In this stage of phlebothrombosis the percentage of patients that enter with signs of pulmonary infarction will be obviously greater. This represented 28 per cent in our series. Some of the patients in addition may complain of a sense of impending disaster.

In summary, the diagnosis of phlebothrombosis of the lower extremities may be based on the following symptoms approximately in the order of their frequency: (1) tenderness, (2) pain, (3) mild swelling of the leg, (4) dilatation of veins of the leg, (5) increased pulse and temperature, (6) cyanosis of the leg in the standing position, (7) pulmonary embolism and (8) sense of impending disaster.

In Stage v the thrombus has progressed up above the femoro-iliac junction and entered the iliac veins. For some as yet unknown reason an associated inflammatory process now exists and here we have the so-called phlegmasia alba dolens or milk-leg with massive edema of the entire lower extremity. There is generally considerable evidence of the vasospasm as manifested by diminished arterial pulsation and often a clammy cold extremity. Associated with this are pain and redness along the femoral vein. There may be associated chills; fever is commonly present and there is a leukocytosis and an elevated sedimentation rate.

If femoral vein section is decided upon as a treatment of choice in any of the first four stages, the preferable sites of election are: (1) Superficial femoral vein section which is carried out in Stages I and II phlebothrombosis without embolism. This includes early tibial and moderately advanding femoral phlebothrombosis. Corroboration of the diagnosis is made at surgery by finding a non-dilated superficial femoral vein devoid of perivascular inflammation. Phlebotomy will disclose absence of clot. The vein can be freed easily from the artery. The profunda should be soft, non-dilated and free of clot. Assuming there is unilateral involvement, the incision should be made in the femoral triangle and the femoral sheath opened and the aforementioned findings sought for. Superficial femoral vein section may be carried out with a reasonable degree of safety. It will prevent the great majority of emboli but will not control a minimal source of future potential emboli from the saphenous and profunda veins. Simultaneously, section at this level will result in little or no permanent postoperative edema. This vein was ligated in 62 per cent of our cases. (2) Independent superficial and deep femoral section is the second choice.

The indications may be (1) therapeutic or (2) technical. In some cases of Stage III phlebothrombosis without embolism there may be clot in the profunda and none in the superficial femoral vein. Under these circumstances superficial femoral section plus profundal section and thrombectomy are indicated. This will provide a reasonably adequate collateral circulation via the muscular branches and the saphenous vein. In other circumstances when the femoral sheath is opened in the femoral triangle one will find that the distance between the point of entrance of the profunda into the femoral vein and the entrance of the saphenous vein into the femoral is exceedingly short, making it technically difficult or practically impossible to clamp, divide and securely tie the common femoral vein adequately between the point of entrance of the profundus and the saphenous. Under these circumstances one can independently free up the superficial femoral vein and then the profunda and divide them independently. This will give similar protection to that afforded by common femoral section. This was carried out only 4 per cent of the times.

Allen[13] carries out this procedure at all times in preference to common femoral vein section, stating that a more adequate col-

lateral circulation prevails. (3) Common femoral section below the saphenous vein is a third type. Our indications for section here are (1) all stages phlebothrombosis with embolism, (2) cases of Stage III or IV phlebothrombosis without embolism in whom anticoagulants are contraindicated. This refers to the case of phlebothrombosis with a well advanced loosely or partially attached propagating embolus present in upper femoral or iliac veins, with or without concomitant clot in the profunda. Here on opening the vein in the femoral triangle one will commonly find clot present at this point. There will be much perivascular reaction and it will be difficult to separate the artery from the vein. Common femoral vein section was carried out in 37 per cent of the cases. Under these circumstances one should perform a proximal and distal thrombectomy by inserting an aspirating cannula into the vein both proximally and distally. A short nick is made in the vein between guy ligatures just above the point of entrance of the profundus and just below the saphenous. If clot is removed proximal to the point of entrance of the saphenous and even up into the iliac vein, one should also make every effort to aspirate all the clot distal to this point to avoid increased edema following femoral section and to improve the collateral circulation more promptly. If clot is present at the point of operation on the femoral triangle, it would appear to be preferable to carry out ligation at a point definitely above the uppermost level of the thrombus through a normal segment of vein.[14] This would mean either common iliac or caval ligation. In our opinion this is not always practical. It is likewise the belief of others. Donaldson[15] of the Massachusetts General group, too, believes that intervention at the iliac or vena caval level is unnecessarily hazardous and carries a disturbing morbidity and forbidding mortality (as shown in a report of caval ligation by Moses, Allen)[16,17] and the Boston group practically never ligate the common femoral vein but prefer superficial femoral vein section and thrombectomy. They ligate the profunda also independently if it is a site of thrombus formation rather than carry out a common femoral section which in their opinion is very disabling. In their clinic (Donaldson) caval ligation is now reserved for patients presenting septic emboli, the source of which is or has extended above the femoral level. However, Veal and De Takats[18] do believe in section through normal vein above the level of the thrombus and do carry out iliac and caval section .Bancroft,[19] on the other hand, endorses common femoral section and thrombectomy if clot has extended up to the level of the iliac vein.

Caval ligation has not stood the test of time and we do not believe that routine common iliac vein ligations are a procedure of choice inasmuch as it generally necessitates the administration of a spinal anesthetic for the conduct of the operation with resultant flexion of the thigh and legs, on the trunk and increased probability of detaching pulmonary emboli which may be fatal. Very often one has a critically ill patient in whom spinal anesthesia is out of the question. Under these circumstances we prefer to carry out common femoral vein section just below the entrance of the saphenous vein. Further, Homans,[20] who is generally considered to be the Dean of the ligation school, has clearly stated what he considers at the present time to be the indications for and preferred levels of ligation. It is to be emphasized that he regards vena caval ligation only as a last resort to be employed when repeated embolism has continued to occur despite peripheral venous ligation and/or adequate anticoagulant administration. His statement that certain forms of peripheral venous thrombosis, in which pulmonary embolism has not occurred, may be adequately handled by medical management reflects a change in viewpoint by the surgical school.

We believe that common femoral vein section is indicated under any circumstances as long as pulmonary embolism has occurred. This is especially true in

Stage I or II phlebothrombosis, for here on opening the femoral vein one will not demonstrate thrombus. However, because pulmonary embolus has occurred and because one cannot be certain with an adequate degree of accuracy that thrombus does not exist in the profunda, we believe the only safe thing to do under these circumstances is to ligate the common femoral vein below the saphenous vein. This will result in greater morbidity as manifested by edema in the lower extremity. Statistically, however, this is a more desirable operation even in early phlebothrombosis in which clot is present only in the calf veins, etc., because one is weighing the possibility of death from another embolus against the factor of morbidity. Obviously the former is the more important objective to overcome.

Common femoral section above the saphenous vein represents the fourth type. This is indicated rarely in cases of the very well advanced phlebothrombosis in which a fully developed femoro-iliac thrombophlebitis does not occur and in which one operates because of recently detached pulmonary embolus. Here findings should demonstrate the presence of clot in the saphenous vein. Under these circumstances the common femoral vein section is carried out above the saphenous vein to prevent the possible detachment of thrombus from the saphenous circulation. Because of marked postoperative edema this is an especial indication, if feasible, for common iliac section.

Based on the above, vein resection may be carried out under the following circumstances: (1) If early diagnosis is made; (2) if anticoagulant therapy is ineffective or contraindicated and (3) if embolism occurs.

On our service the following plan of management of phlebothrombosis of the lower extremities is carried out. In Stages I, II, III and IV phlebothrombosis without accompanying pulmonary embolism we routinely start anticoagulant therapy at this time. This is based on statistical evidence as exemplified by the Mayo Clinic where Barker[21] et al. showed that in a group of a thousand surgical patients who were given Dicumarol in their immediate postoperative period for the purpose of preventing venous thrombosis and pulmonary embolism, only one death occurred from pulmonary embolism. This occurred after the prothrombin had returned to normal because Dicumarol had been given for an insufficient time. In their group they state that the extremely low incidence of fatal pulmonary embolism in a thousand postoperative cases would not be remarkable if the cases had been unselected but most of them for a matter of fact had been selected. The thrombotic tendency had already been demonstrated in 379 patients in that they already had thrombosis or embolism. In 438 abdominal hysterectomy had been performed, an operation in which the statistical risk of thrombosis and embolism is known to be greater than in most operations. Hence, based on the above study over 40 per cent of the patients had already developed phlebothrombosis and were given therapeutic Dicumarol. The above is also borne out in other studies. Lowe[22] has demonstrated the effectiveness of heparin in Pitkins menstruum in thromboembolism both prophylactically and therapuetically. Bauer,[23] of the Swedish group, has employed regular heparin with success. He strongly endorses it in the treatment of deep venous thrombosis.

Based on these statistics we believe that it is reasonably safe to institute anticoagulant management once the diagnosis of phlebothrombosis without embolism has occurred. We believe also that anticoagulants will protect the patient against an embolus in the greater majority of instances although this is not exclusively so. This is borne out by the experience of Ochsner[24] who observed emboli in patients who were under adequate anticoagulant effect. Emboli occurring under similar circumstances have also been reported by Cosgriff.[25] In his series ninety-six patients presenting the clinical picture of acute deep

venous thrombosis of the lower extremities were treated with anticoagulants, such as heparin and Dicumarol. With the exception of six patients treated with heparin alone and two with Dicumarol alone, all patients received Dicumarol with concurrent heparinization during the first one to three days of the treatment period. Subsequent to starting therapy, three patients experienced small non-fatal pulmonary emboli. All of these emboli occurred prior to the sixth day of *adequate* anticoagulant effect, one following almost immediately after manipulation of the patient during the administration of a paravertebral lumbar sympathetic block. No fatal emboli occurred in any patient of this group.

Embolization was encountered in three of the ten cases of acute thrombophlebitis of the deep veins. Examples such as these three cases have served to strengthen our belief that even the acute inflammatory deep venous thromboses (thrombophlebitis) should receive anticoagulant treatment as well as symptomatic measures such as sympathetic block because of the possibility of dangerous bland thrombus material either proximal to the inflammatory thrombosis or in the contralateral deep venous system. An embolus occurring during treatment with anticoagulants is further illustrated in the following case:

The patient had a subtotal gastric resection carried out for carcinoma of the stomach. About the tenth postoperative day he began to show signs of phlebothrombosis in one leg. He was placed on anticoagulant management with adequate doses of Dicumarol and heparin. About the third or fourth day after the institution of anticoagulant management he developed evidence of a pulmonary embolus. This was not confirmed by radiograph, however. The findings were those of severe pain in the chest, precordial pressure, dyspnea, cyanosis, shock and hemoptysis, the classic findings of pulmonary embolism with associate accompanyings of elevation of temperature and pulse. It is possible that he may have had a retrocardiac pulmonary embolus which was not visualized on x-ray. Examination at the time disclosed findings co-existent with diagnosis of Stages II or III phlebothrombosis. He had a positive Homans' sign, dilated superficial veins, slight cyanosis of the leg and very early edema. It was believed that we were dealing with a Stage III phlebothrombosis. Anticoagulants were discontinued. He was given vitamin K and whole blood and within eighteen hours common femoral section was carried out. Thrombus was not demonstrated in the common femoral vein; however, because the patient had had a pulmonary embolus, common femoral vein section was carried out. He made an uneventful recovery and had just a minimal amount of residual edema.

In Stages III and IV phlebothrombosis, with anticoagulants contraindicated, without embolism, femoral vein section with proximal and distal thrombectomy is carried out. Here the superficial or common femoral vein is ligated depending upon the site and amount of clot. Distal thrombectomy helps reduce postoperative edema.

On the other hand, irrespective of the stage of thrombosis but exclusive of acute femoro-iliac thrombophlebitis, once a pulmonary embolus has occurred we believe the only safe thing to do is to carry out common femoral vein section, preferably below the saphenous vein. Under these circumstances it is considered unwise to institute only superficial femoral vein section even if a thrombus is not demonstrated at the level of phlebotomy. Our reasoning here is based on the statistical evidence of 3 to 4 per cent[26] chance of further emboli with a 1 per cent mortality. Our postoperative mortality under these circumstances was 2.4 per cent. It is then clear that in superficial femoral vein section there is no protection against pulmonary emboli arising from the profunda, the saphenous vein or possibly the other leg. Fine and Sears[27] share the same belief. They state: "Regarding the safety of ligating the superficial femoral vein one is impressed by the frequent efforts reported to preserve the profunda femoris vein, but the attempt is not safe. The site of thrombosis may be in this very vein and the patient may die of embolism."

About three of four years ago superficial femoral vein section was our practice in Stages I and II phlebothrombosis with emboli. However, following the occurrence of a death in one of our patients under these circumstances the procedure was abandoned and since then common femoral section as described earlier has been our policy. While common femoral vein section as above is the procedure of choice in phlebothrombosis Stages I, II, III, and IV with pulmonary embolism, it is not a completely adequate procedure in the light of our present experience. More adequate management is effected by complementing the above surgery with anticoagulant treatment. The basis for this lies in our own experience and that of others. We observed post-ligation embolism early in about 8 to 10 per cent of cases.

Donaldson[28] reporting on a series of 3,185 femoral vein interruptions in 1,692 patients over a ten-year period from the Massachusetts General Hospital cited a 4 per cent incidence of post-section pulmonary emboli. It is of interest that practically all of this group who suffered subsequent pulmonary emboli had been subjected to femoral vein interruption because of previous pulmonary infarction. Of the 3,185 sections about two-thirds were for active disease and one-third were carried out as a prophylactic measure. Five patients in the group of 1,033 therapeutic interruptions succumbed to proven subsequent emboli. In none of these earlier cases was anticoagulant treatment used.

Other additional valid reasons for advocating the use of anticoagulant treatment following ligation may be advanced from the following: Murray[29] has emphasized the usefulness of heparin administration in the patients with severe pulmonary embolism. He believes that propagation of thrombus material from the site of embolus lodgment may be avoided if anticoagulant administration is immediately started and the incidence of fatality due to the original acute episode thus reduced. De Takats[30] analyzed a group of patients who died from pulmonary embolus and concluded that 60 per cent live for a period of one hour to several days. He concluded that if the cause of some of the delayed deaths from pulmonary embolism is the propagation of thrombus material in the pulmonary artery, a fertile field of endeavor is opened to the employment of anticoagulants. Carlotti et al.[31] in a recent report from the Massachusetts General Hospital stated that thrombus formation proximal to the site of venous ligation was found in more than 50 per cent of a small group of medical pulmonary emboli patients who were treated by ligation and later examined at autopsy. These two preceding reports suggest that there is a rational basis for the employment of anticoagulants even as an adjunct to ligation. Carlotti[32] also reported a 21 per cent incidence of postoperative pulmonary infarction in a series of sixty medical patients who had common femoral sections. Veal and Hussey[33] observed three deaths from massive pulmonary embolism in cases of acute ileofemoral thrombophlebitis in which a new clot was engrafted on the old. They expressed the opinion that there is danger of embolism in all cases of venous thrombosis for as long as four months afterward. Their preference is to ligate the common femoral vein distal to the saphenous vein. In forty-five ligations there were 20 per cent instances of embolism after ligation in the cases in which ligation was performed before the embolism was evident. The above is additional evidence that a need exists for post-ligation anticoagulants.

With the above supporting evidence we now institute anticoagulant (unless contraindicated) treatment about twelve hours following common femoral vein section for Stages I, II, III and IV phlebothrombosis with embolism. We use both heparin and Dicumarol in our clinic, carrying the patient on heparin until there is an adequate Dicumarol effect noted as evidenced by a sufficient depression of the prothrombin level of the blood.

The detailed management of Stage V

phlebothrombosis which is acute femoroiliac thrombophlebitis does not fall into the realm of this paper. It is generally agreed that treatment should be directed toward relief of vasospasm by (1) repeated paravertebral lumbar sympathetic blocks (2) heat and (3) drugs that produce block of autonomic impulses such as etamon. Further attention should be given to the systemic effects of the disease by general support and chemotherapy, etc. In addition, because of the occasional embolic phenomena in thrombophlebitis we now recommend the use of anticoagulants. This is given in conjunction with the above measures.

We have had three cases of femoroiliac thrombophlebitis, one acute and two chronic recurrent cases that have had embolic phenomena. Fortunately, none of the three were fatal. This is again mentioned to dispel the laissez faire attitude that we and probably others have previously had about emboli under these circumstances.

The frequency and relationship of unilateral and bilateral phlebothrombosis is variously related. The literature indicates that bilateral phlebothrombosis occurs with much greater frequency than unilateral. These observations are stressed in the works of Homans[34] and Allen and Linton,[35–37] all of the Boston group. They believe that the site of thrombosis in the lower extremities is difficult to determine and they advocate bilateral femoral vein section. In our group of cases bilateral femoral phlebothrombosis was diagnosed in 9 per cent of the cases.

The indications for therapeutic unilateral or bilateral femoral vein sections may be based on findings of physical examination. If one can demonstrate to his own satisfaction the presence of phlebothrombosis in a particular extremity, he should treat it as such. On the other hand, unless there are actual positive findings present in the opposite extremity, it is our belief that one need have little fear concerning the presence of an embolus arising in the opposite extremity. This observation is made with the provision that the extremity be watched often enough and closely enough. Under these circumstances if phlebothrombosis should develop in the opposite extremity, it would be discovered very early. If it did develop subsequently, the same principles of management should be effected. This, too, is in accord with the ideas of Bancroft, who in a recent discussion on thromboembolism stated: "I disagree with Allen and his co-workers that it is necessary to ligate both sides every time; in my experience if the thrombus starts in the veins of the calf and is seen early and that vein is ligated then I have *never* seen it occur on the other side."

The matter of bilateral superficial femoral vein section as a prophylactic measure to be carried out more or less anticipating possible emboli in certain patients, especially the older age groups who are to have radical surgery for malignancy, etc., is an entirely different matter.

In determining the sites of femoral vein section one critical consideration should be the postoperative morbidity, especially the degree of postoperative edema that may ensue. Obviously it is desirable to ligate the femoral vein as low as possible. The lower the ligation the less the edema. If one can safely carry out superficial femoral vein section, this should be the procedure of choice in respect to the amount of resultant edema. In our study superficial femoral section practically never resulted in permanent edema. If edema did develop immediately after operation, it was minimal and more or less disappeared completely in a very short time. On the other hand, section of the common femoral vein below the saphenous system will result in varying degrees of edema. Several years back practically all of the patients developed an appreciable degree of edema with common femoral section. Of those that were followed, notably two, phlebitic ulcers developed which were refractory to treatment. At the present time we are not quite as concerned about ligating a common

femoral vein as we were formerly. This is because of more detailed attention to leg care with less resultant edema. Special emphasis should be placed on adequate elevation of the leg immediately after operation and the use of ace bandaging of the extremity for several months. On the other hand, in common femoral section above the saphenous vein there is practically always a marked degree of edema. This operation is rarely indicated. Edema ensues essentially because the complete circulation of the lower extremity is abruptly occluded at one time and the collateral circulation develops very slowly.

At this time mention should be made of the place of venography, (1) in the diagnosis of phlebothrombosis and (2) as an aid to femoral section. Several years ago venography played an important role in establishing a diagnosis of phlebothrombosis of the lower extremities. As time went on it became apparent, however, that the venogram was not always diagnostic and was a rather difficult type of radiogram to interpret. This has been our experience; and whereas formerly we did venograms on practically all cases of whom we suspected phlebothrombosis, we now have largely abandoned this procedure. At present it is only an exceptional case in which venography is done. We believe that the diagnosis of phlebothrombosis can be made principally on physical findings. In addition, venography may also be misleading in that it is difficult to assess the normal from the abnormal because of the numerous anomalies that are present in the deep venous circulation of the lower extremities. Before being able to read a venogram accurately, it is necessary to do a good number of normal lower extremities to determine what the normal is. Only then can one appreciate the abnormal. We originally carried this out in a representative number of normal cases and even after that it was found by both the radiologist and myself that accurate interpretation of venograms was often difficult, especially when only the anterior and posterior tibial and peroneal veins were involved. When the thrombus has progressed to the popliteal vein or into the femoral vein, the venograms are usually quite clear. On the other hand, physical findings under these circumstances were so obvious that a venogram was really not necessary anyway. This is the consensus held by most men interested in the problem, and most of them also have abandoned venography as an adjunct to the diagnosis of phlebothrombosis. As far back as 1944 and 1945, Barker[38] and his group noted that venography gave no positive results in about a third of his cases. He was in favor of abandoning it at that time and as far as we know he has done so since then. Similarly Kleinsasser,[39] in a study of serial phlebograms made in 110 cases of intravascular clotting at the DeWitt General Hospital vascular center, concluded that they were of no value so far as early detection of phlebothrombosis was concerned and also of no value in identifying its location even when the occurrence of pulmonary embolism had directed attention to its existence. His conclusion was that a recollection of the possible occurrence of the condition was of far more value than any laboratory method.

Any presentation of phlebothrombosis would be incomplete without reference to the role of prophylaxis. Here may be mentioned suitable preparation of the patient for operation. This should include reduction of weight if the patient is obese, correction of anemia, elimination by injection or surgical resection of major varices in the lower extremities, medical supervision of cardiac abnormalities, adequate diet and adequate physical activity preoperatively. Gentle handling of the tissues in surgery and prevention of stasis in the leg veins during convalescence, elevation of the foot of the bed and leg exercises are widely considered useful. On the other hand, there is still reasonable doubt as to the true value of early ambulation as an effective prophylactic measure against thromboembolism. Allen[40] remarks about the reduction in the

over-all incidence of thrombosis and fatal embolism in postoperative cases from 1 in 333 to about 1 in 800 at the Massachusetts General Hospital. On the other hand, Powers[41] in a recent clinical study of the effects of early ambulation in 1,590 major surgical cases concluded that the incidence of postoperative thrombosis was not favorably influenced nor was the hazard of pulmonary embolism eradicated. He believed than an early return to customary activity following early ambulation was the only beneficial effect. Still more significant are the findings of Blodgett and Beattie[42] who analyzed 681 cases at Peter Bent Brigham Hospital and observed that following early postoperative rising the incidence of deep leg vein thrombophlebitis was actually somewhat greater in the early rising group.

Therefore, inasmuch as avoidance of unnecessary prolonged bed rest by early ambulation has not eliminated thrombotic phenomena, it is only logical to single out individuals on whom clinical experience has shown have an increased predisposition to thromboembolism. Active prophylactic measures could be carried out in *this* group. The group should include the following circumstances: (1) A history of previous thromboembolism predisposes to recurrence. (2) Disturbances of venous circulation, such as extensive varicosities, favor the development of thromboses. (3) Individuals with malignancy suffer more frequent and recurrent thromboses. (4) Extensive abdominal and pelvic surgical procedures, particularly those performed for malignancy (such as abdominoperineal resection for cancer of the rectosigmoid), are complicated by far more than the average number of thrombotic phenomena. (5) Fractures of the femur and amputations of lower extremities are followed by a remarkably high incidence of thromboembolism (as high as 10 per cent of fatal embolism in older patients). (6) More than 60 per cent of all postoperative venous thromboses and emboli occur in the age group over fifty years and more than 80 per cent in the age group over forty years. (7) Thromboembolism occurs at least twice as frequently in obese individuals as in those of normal weight. (8) Cardiac insufficiency, with its attendant disturbances of venous return, greatly increases the risk of thrombotic episodes.

COMMENT AND CONCLUSIONS

Phlebothrombosis with its thromboembolic complications continues to be a problem in management. It is believed that the pathogenesis and sites of origin are now generally known. For clarity these points have been re-emphasized and reviewed. Thrombosis begins in the deep veins of the leg and foot and may propagate and go on to embolism before it gives rise to marked clinical manifestations. It is necessary, if it is to be detected before complicating embolism has occurred, that the possibility be borne constantly in mind. It should always be considered as a possible development after operation. It often occurs in medical patients. Detection is a matter of constant watchfulness. It involves repeated palpation of the extremities, the taking and recording of serial measurements and repeated observations of the pulse rate, temperature and respiration. Electrocardiography may be very useful but venography has declining importance as a diagnostic aid. The value of electrocardiography has been graphically demonstrated in our clinic; in at least five of our cases phlebothrombosis was diagnosed only after the cardiologist discovered evidence of acute cor pulmonale on the electrocardiograms compatible with pulmonary embolus; then after more careful examination of the extremities thromboembolic disease was ascertained.

Despite the voluminous literature written on the subject a misunderstanding as to the indications and levels for femoral vein section still exists. This is based on disagreement among the leaders in this type of management. We believe many factors should be taken into account in determining levels for section. We especially emphasize the role and place of physi-

cal findings. Other important factors to consider are postoperative morbidity, sequelae, the reliability and effectiveness of anticoagulant agents, prophylactic measures and finally the incidence of pulmonary embolism under various conditions and especially after femoral section at different levels. A big problem is the unknown degree of danger in each case of phlebothrombosis. The dangerous character of phlebothrombosis is evident from the fact that it is frequently unsuspected until potentially fatal accident of pulmonary embolism occurs. Every detection is difficult unless the condition is constantly being suspected. The existence of this problem is emphasized when it is noted that statistics show that 2½ to 5 per cent of deaths are attributable to pulmonary embolism. If the pulmonic process is not properly diagnosed, the patient may continue to have showers of pulmonary emboli which are regarded as manifestations of pneumonia or cardiac disease and which may eventually terminate fatally although this is not an inevitable end result. Pulmonary infarction was fatal twice in our small series after ligation. Pulmonary infarction was not fatal in any case of an army series of 502 instances (Kleinsasser).[43]

White[44] has commented on the increasing number of cases in his own experience which he once would have diagnosed as congestive heart failure but which he now recognizes as pulmonary embolism originating in phlebothrombosis; the cardiac disease, of course, is a possible complication. In seventy-five cases which White studied and in which cardiac disease was a possibility, it was actually present in forty-seven; the remaining twenty-eight were true instances of pulmonary embolism originating in phlebothrombosis. In his experience at the Massachusetts General Hospital 70 per cent of the patients with pulmonary embolism of non-surgical origin had symptomless clotting insidious in onset and situated in the deep veins. The differential diagnosis of pulmonary embolism is frequently possible on the basis of periodic attacks of faintness, dyspnea, prostration, unexplained fever, leukocytosis and, rarely, jaundice. X-ray diagnosis is often disappointing except in the case of wedge-shaped infarctions. Suspicion of the possibility of embolism and constant close observation is the key to successful diagnosis. Once pulmonary infarction has directed attention to the existence of intravascular clotting it is urgent that measures be taken to prevent its recurrence since this is a real possibility. Ziak[45] pointed out that 70 per cent of patients who die from pulmonary embolism have had previous attacks of pulmonary infarction, and Graves in a study of 194 cases found that while 140 patients had only a single attack, some had as many as eight.

Not more than 20 to 25 per cent of all pulmonary emboli are immediately fatal. According to Ziak at least 60 per cent of the patients live from one hour to several days. In only forty-five of 154 fatal cases in the Graves series did death occur within an hour or less. De Takats and Fowler[46] have also emphasized the fact that in most instances of embolism there is time for treatment, first, during the actual episode, then for the prevention of other attacks which are increasingly dangerous as their number increases. Approximately one-fifth to one-fourth of these emboli are fatal at the outset.

We treat all phlebothrombosis without pulmonary embolism with anticoagulants (heparin and Dicumarol) unless there is a contraindication to their use. In phlebothrombosis with embolism we carry out common femoral vein section below the saphenous vein with or without thrombectomy as indicated. This is usually unilateral and much less frequently bilateral. We advocate postoperative anticoagulants as an additional safety factor here. Superficial femoral vein section is usually adequate in our so-called Stages I and II phlebothrombosis without embolism. In Stages III and IV without embolism both superficial and femoral vein ligation may be necessary. More often common femoral

section without thrombectomy is indicated here. We do not hesitate to ligate the common femoral vein. We prefer it to common iliac and caval section notwithstanding the supposed more adequate collateral circulation. Common iliac and caval section do have their shortcomings and dangers. Femoral section is rarely if ever indicated in acute femoral iliac thrombophlebitis. Here measures should be directed toward relief of vasospasm and toward the systemic aspect of this disease. In addition we now recommend anticoagulant measures to prevent the occasional pulmonary embolus that can occur and we highly recommend detailed attention to prophylactic measures.

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THE Thirteenth Congress of the International Society of Surgery will meet in New Orleans October 12th to 15th, inclusive. A distinguished gathering is expected from the United States and many foreign countries. An excellent scientific program has been arranged. There are four scientific sessions but the last two days of the meeting will be given over to an American program, all the speakers being from the United States. Honorary chairman is Dr. Rudolph Matas in whose honor New Orleans was chosen for this year's meeting. Dr. Matas is the only living American past president of the Society. The other American president was the late Dr. W. W. Keen of Philadelphia who was elected in 1914 when the Congress met in New York.

CLINICAL EVALUATION OF A NEW BACTERICIDAL AGENT*

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THE purpose of this paper is to give the results of a clinical study of infected wounds using a new bactericidal agent, Heliogen, in comparison with accepted chemotherapeutic agents.

Heliogen is a white powder composed of the mixture of chloramine-T, potassium iodide, dextrose and sodium biphosphate in definite proportions. The pH of the preparation is close to neutrality changing from 7.32 to 7.03 after thirty minutes at room temperature. On contact with water iodine is released.

As the name Heliogen implies, a small amount of ultra violet light is emitted as a result of the chemical reaction which the preparation undergoes in solution. The wave length has been determined by Dr. Ralph H. Müller, Washington Square College, to be in the range of 2,850 to 3,000 Ångströms. This is an interesting observation from the academic point of view and, as the reader doubtless knows, is not a unique phenomenon. An example familiar to every one is the luminescence of biochemical origin which has been studied and described in a monograph by Harvey.[1]

Bactericidal tests *in vitro* have shown that Heliogen is effective in killing a wide variety of micro-organisms. Toxicity studies by the Department of Therapeutics of The New York University College of Medicine indicated that Heliogen preparations were, "of sufficiently low toxicity to warrant controlled clinical study at the hands of properly qualified investigators." In these clinical studies Heliogen was used in two forms: (1) a powder for preparing an aqueous solution; (2) a powder for dry application which had a much lower content of iodine in order to avoid excessive concentration in tissue fluids.

Conditions were kept as constant as possible. Dressings were applied daily by the same team at the same hour of the day, wound cultures were collected in the same way and the general management of the patient's systemic condition and regulation of his activity remained consistent throughout. In each of the controlled series patients were assigned in rotation to each type of therapy so that no extrinsic factors entered into the selection. The fact that this study was completed before penicillin was generally available accounts for the lack of mention of its use in many cases in which patients might have benefited from it and even survived the overwhelming infection which produced some of the mortalities.

SERIES I: PRELIMINARY GROUP

All but two of the twenty-one patients had chronically infected wounds which had not responded appreciably to various treatments including antiseptics and the sulfonamides.

In this series no controls were used but it was thought that the results were significant because of the various therapies tried unsuccessfully before admission of the patients to this series; an example is Case 10. The patient was a nine year old boy with a wound infected for two and a half years following a thoracoplasty. Previous treatments consisted of sulfathiazole, gen-

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tian violet packing, zinc peroxide, azochloramid and Dakin's solution. After Heliogen irrigations were begun, the discharge rapidly decreased. Clean granulations started at the lower border of the wound. A subpectoral abscess of the right chest wall was incised and drained. Following this the amount of discharge from the sinus diminished greatly and epithelization at both ends of the wound progressed rapidly. The patient was discharged after seventy-one days with the wound practically healed.

All wounds were irrigated with Heliogen solution; in eight cases this was followed by application of the powder in dry form.

A review of these cases leads us to the following conclusions: (1) In no case was there any undesirable effect from Heliogen treatment either locally or systemically. (2) The growth of granulations was not inhibited and in some cases epithelization seemed to be hastened. (3) In no case was there an exuberance of granulations. (4) The appearance of the scar tissue was good. (5) There was usually in grossly infected wounds a slight discomfort lasting about fifteen to twenty minutes after irrigation but this disappeared as healing progressed. (6) Chronically infected wounds which had been resistant to various other therapies seemed to progress favorably under Heliogen treatments.

SERIES II: CONTROLLED GROUP

*Solutions.** Patients with infected wounds which appeared to have free drainage were selected and assigned in rotation to one of four types of therapy. The substances used in treatment were:

1. Saline and peroxide, ten cases
   Physiologic saline 75 per cent by volume
   Hydrogen peroxide 25 per cent
2. Heliogen powder for solution, ten cases
   2.5 to 10 Gm. in 1 L. of water
3. Compound solution of iodine, U.S.P. XI, ten cases
   Iodine concentration equal to that of Heliogen
4. Azochloramid in saline, ten cases
   Dilution 1:3300

* Both controlled series of cases were carried out after consultation with the Committee on Chemotherapeutics and other Agents, National Research Council.

Saline and Peroxide. Two of the patients in this group expired from extraneous causes. In Case 26 the wound showed 10 per cent healing after twelve days of irrigation with saline and peroxide. The patient expired with jaundice on the thirteenth day. In Case 64, after irrigations of a decubitus ulcer with saline and peroxide for three days, the wound had shown no progress; the patient expired from advanced carcinoma of the cervix. One patient (Case 42) would not cooperate in keeping fecal matter from the wound, which failed to improve with three days of saline and peroxide irrigations and thirty-seven days of Heliogen treatments.

In the remaining seven cases wound progress with saline and peroxide was satisfactory but in general healing was slow, as in Cases 38, 26, 46 and 30. In three of these cases the patients required additional therapy with saline irrigations or daily hot baths before healing was complete.

There was no undesirable reaction to the saline and peroxide treatments either locally or systemically.

Compound Solution of Iodine, U.S.P. XI. Of the ten in this group three patients expired. In Case 60 the wound was an infected amputation stump of a diabetic. After fourteen days of aqueous iodine irrigations the infection was spreading and six days of Heliogen therapy were without effect. Additional drainage of the wound was necessary but the patient's systemic condition did not permit operation and death ensued from cardiac failure.

In Case 24 a deeply infected amputation stump of a diabetic failed to respond to three days of aqueous iodine irrigations and the patient expired of generalized gas gangrene. The patient in Case 52 was also a diabetic. After eight days of aqueous iodine irrigations the infection was not

controlled and the patient expired with diffuse infection and spreading gangrene. In case 44, after eight days of irrigation with aqueous iodine, the wound was worse. The patient was discharged with a gelatine paste boot and subsequently improved.

Two patients (Cases 40 and 56) showed but slight improvement under aqueous iodine therapy. They were transferred to Heliogen treatments and progress was made. These cases are discussed under Changes of Therapy. In one patient (Case 32) the wound showed 80 per cent healing in thirty-eight days of aqueous iodine irrigations and then remained static. In twelve days of subsequent Heliogen therapy the wound healed completely.

In the remaining three patients (Cases 28, 36 and 48) the wounds healed completely under iodine therapy. In Case 48 an infected laceration of the knee 7 cm. in length required skin grafting. The first attempt did not take but the second succeeded. In Cases 28 and 36 the wounds healed satisfactorily.

In general wounds treated with aqueous iodine became clean but progress was of very limited proportions. The majority of the patients complained of a moderate burning sensation of thirty to sixty minutes' duration following each irrigation. No systemic toxicity was observed but there was one instance of skin irritation (Case 32).

*Azochloramid.** Two of the ten patients in this group expired from systemic conditions. In Case 23 the patient was admitted with cerebral concussion and multiple fractures. Seventeen days later a decubitus ulcer developed and eleven days afterward an abscess of the leg. Under daily irrigations with azochloramid both wounds failed to improve and the patient expired from bronchopneumonia thirty-eight days after treatment began.

When admitted, the patient in Case 35 was very weak. There were two wounds; one was an infected ulcer of five years' duration which was treated with azochloramid; the other (later) a gangrenous decubitus ulcer on which Heliogen was used. After twenty-three days of azochloramid the ulcer was cleaner and had decreased 25 per cent in size. After six days of Heliogen irrigations the spread of gangrene was halted in the ulcer. However, the patient's condition deteriorated and she expired twenty-four days after treatment began.

In two cases azochloramid was discontinued because of a severe, burning sensation from the treatments. In Case 27 the foul-smelling discharge disappeared after ten days of azochloramid irrigations but because of severe pain, the therapy was changed to normal saline irrigations. The wound healed completely in thirty-eight days. After eight days of azochloramid irrigations the patient in Case 31 refused further treatment of infected burns because of the severe pain. At that time there was no change in the culture and very little healing.

Of the remaining six cases, two patients showed no improvement under azochloramid (Cases 38 and 55) and one became worse (Case 51) but all three improved under Heliogen treatments.

One patient (Case 43) showed no improvement with either azochloramid or Heliogen treatments but an exploratory operation revealed osteomyelitis deep in the pelvis. Another patient (Case 47) showed a slight regression of the wound but no change in its appearance after twenty days of azochloramid irrigations. The wound healed completely in forty-two days with repeated hot Sitz baths. In Case 59 a satisfactory course was followed under azochloramid treatments. There were two wounds, one of which healed completely; the larger one was practically healed after fifty days of treatment.

The results obtained with azochloramid were disappointing. The wounds, except in Case 31, appeared clean after irrigations but the expected healing did not occur.

Heliogen Solution. In this group of ten cases one patient expired. In Case 45 the

* Supplied by Wallace and Tiernan Company.

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FIG. 1 CASE 25. Appearance of lesion nine days after Heliogen treatment was started. The patient is lying on his side with his head at the left and his right arm at the top of the picture. The wound extends subcutaneously in all directions, connecting at the inferior border with the sinus seen at the extreme right of the picture. Anteriorly and posteriorly there are deep cavities formed by the arching of the remaining ribs and the scapula. The papulo-pustular rash appears to have been associated with an aerobic Actinomyces; actual size.

FIG. 2. CASE 25. Appearance of lesion on the 190th day after Heliogen irrigations were started, the thirteenth day after they were discontinued. The papulo-pustular rash has cleared up. The chest has expanded somewhat allowing the scapula to be pulled up higher, but in addition there has been extensive growth of new skin between the old sinus, which is now healed, and the main wound. No healing has been possible where the trapezius muscle and anterior ribs are holding up the upper layer of skin from the granulating base of the wound which covers the pleura.

3 4

FIG. 3. CASE 41. Appearance of wound ten days after treatment with Heliogen solution was started eighteen days after operation. There has already been considerable healing of the lower end of the incision where two granulating areas formerly connected. The greenish necrotic tissue seen in the wounds is fascia and tendon which had to be removed gradually because of the bleeding encountered. A stab wound which was made for independent drainage of a small pocket communicates with the lower wound and can be seen below it. There is also evidence of healing around the edges of the upper wound which was not present when Heliogen was started.

FIG. 4. CASE 41. Appearance of wound at the second operation, the sixtieth day after Heliogen therapy was started and the sixtieth day after the first operation. This wound connects on the surface the deep portion of the original wound with the stab wound seen in Fig. 5. The original wound is otherwise almost healed. The new wound presents the characteristic appearance of a fresh wound in tissue with poor circulation, pale and apparently lifeless, with a thin discharge.

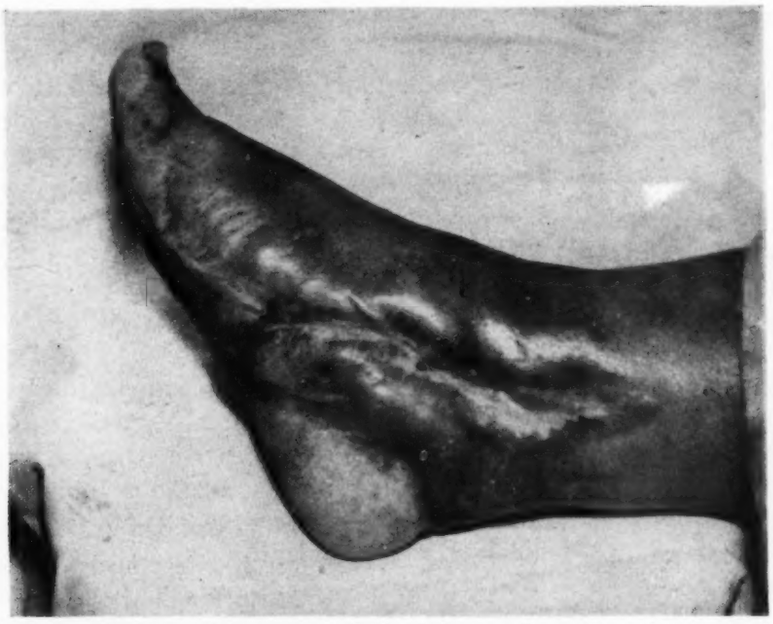

FIG. 5. CASE 41. Appearance of the foot 114 days after the start of Heliogen treatment, 122 days after the first operation and 87 days after the second operation. Complete healing has resulted with a comparatively small scar; one-third actual size.

diabetic patient had a temperature of 105°F. The diabetes was brought under control and the wounds gradually became clean. Although sulfathiazole and sulfadiazine were given orally, blood stream infection persisted and death ensued with the wounds 20 per cent healed.

Two wounds required additional surgery to bring about complete healing. In Case 37 the wound was a chronic empyema cavity. The patient ran a low grade temperature and required blood transfusions. After twenty-five days of Heliogen irrigations there was no change in the size of the wound but there was some diminution in the discharge. The wound needed additional drainage; the patient was referred for necessary surgery and lost to follow-up. In Case 25 (Figs. 1 and 2) the patient had been hospitalized for fifteen months while a chronic draining wound following a thoracoplasty for empyema was unsuccessfully treated with sulfathiazole, Dakin's solution and azochloramid. Under Heliogen therapy the lower portion of the wound filled in, obliterating a dead space and closing a sinus. Epithelization of the exposed granulating base then began. Healing was not complete because of the roofing effect of the ribs. When referred for surgery, the patient had been ambulatory for four months.

Wounds in the remaining seven cases healed completely or showed marked progress under Heliogen irrigations. Two cases are particularly noteworthy because of the difficult problems involved.

The wound in Case 33 was due to a left nephrectomy for tuberculosis of the kidney. The patient's general condition improved, but after three months' treatment with gauze packing, sulfanilamide, sulfathiazole and irrigations with mercurochrome, the wound had not improved and was still discharging. After ten days of Heliogen therapy the discharge was diminished and the wound began to heal. Improvement continued under this treatment until an area only ½ cm. in diameter remained; a complete excision of the scar tissue was then made. There was perfect healing by primary intention. Case 41 (Figs. 3, 4 and 5) is of interest because of the relatively small scar tissue from two grossly infected connecting wounds measuring 14½ by 4½ cm. and 11½ by 2½ cm.

It should be noted that in this group all the wounds had mixed infections and there were some adverse systemic conditions (Cases 29, 41, 45 and 57). Nevertheless, eight wounds showed complete healing or marked progress, one showed 20 per cent healing and in the remaining case a diminution of discharge indicated a slight improvement.

Although several wounds were irrigated daily for long periods because of the nature and extent of the lesions (Cases 25, 33 and 41), there was no evidence of skin irritation or other toxicity. Some patients complained of a moderate burning sensation lasting ten to twenty minutes following irrigations.

SUMMARY OF SERIES II

1. In the saline and peroxide group, although healing occurred without deleterious effects, the progress of wounds was, in general, slow.

2. Aqueous iodine irrigations appeared to clean the wounds and a number of them showed progress but this was, in our opinion, of moderate proportions.

3. With azochloramid the discharge in most cases cleared up following irrigations but the wounds did not show the improvement for which we had hoped.

4. With Heliogen irrigations the results confirmed those of the initial series. The odor and discharge of wounds cleared up rapidly and the wounds either healed completely or showed decided improvement.

SERIES III: CONTROLLED GROUP

Powders and Hypertonic Soaks. Cases were selected and assigned as in Series II. Before application of the powders, the wounds were irrigated with Ringer's solution. With both powders and soaks, wounds were covered with vaseline gauze

except in cases in which it appeared to interfere with the action of Heliogen powder. The substances were: (1) sterilized buffered sulfanilamide powder, ten cases; (2) sterilized sodium sulfadiazine powder, ten cases; (3) sterilized saturated solution of sodium sulfate, ten cases; (4) Heliogen powder, ten cases.

Buffered Sulfanilamide. Buffered sulfanilamide was used in the first group of cases because recent studies by Schmelkes et al.[2] and Fox and Rose[3] had shown that buffering increased the absorption of the sulfonamides.* The amount of powder used was dependent upon the size of the wound, varying from 0.5 to 5.0 Gm. The average blood level twenty-four hours after application of the powder was 0.74 mg. per cent, the highest being 4.0 and the lowest 0.1.

Of the ten cases in this group, two patients expired from extraneous causes. In Case 71 a fifty year old diabetic had an infected postoperative wound which was treated with buffered sulfanilamide. The patient expired in shock the fifth day from general peritonitis, probably due to a rupture of the bowel. Case 67 was a fifty-six year old diabetic. A necrotic area due to cellulitis was excised and the wound treated unsuccessfully with various types of therapy, i.e., hydrogen peroxide irrigations with sulfathiazole powder, Ringer's solution irrigations with buffered sulfanilamide powder, Ringer's solution irrigations with sodium sulfadiazine powder, Ringer's solution irrigations with Heliogen powder and Heliogen solution irrigations with Heliogen powder. Wound edges were then approximated and the wound disturbed only once in every four or five days for irrigations with Heliogen followed by Heliogen powder. After eleven days of this treatment the wound had decreased in size and was beginning to heal. Two days later the patient died from jaundice brought on by some intestinal crisis.

Of the other eight cases, one wound failed to progress (Case 63) and one improved only slightly (Case 95). These were transferred to Heliogen therapy with subsequent improvement. Three wounds showed initial progress under buffered sulfanilamide but then became static (Cases 79, 83 and 87). Under Heliogen therapy progress was observed in all three cases. Of the three remaining wounds, one (Case 75) showed marked improvement on discharge, one was practically healed (Case 99) and one was completely healed (Case 91). In the last case only diphtheroids were cultured.

In summary, the majority of the wounds treated failed to show the expected favorable response so much so that six out of the ten cases were transferred to other forms of therapy. Although the wounds remained clean, progress after a certain period stopped or was too slow. This buffered sulfanilamide was poorly absorbed as evidenced by the amount of powder found in the wounds at each dressing and by the low blood levels. In one instance, (Case 63) a maculopapular eruption appeared during the twenty-four-hour period after a single application of sodium sulfadiazine and seemed to be a delayed reaction to sulfanilamide which had previously been administered for nine days. The blood level had not risen above 0.7 mg. per cent.

*Sodium Sulfadiazine.** The amount of sodium sulfadiazine used varied from 0.5 to 5.0 Gm. depending on the size of the wounds. The drug was readily absorbed. Twenty-four hours after application no powder was visible in the wounds and the average blood titer was 1.49 mg. per cent, the highest being 7.30 and the lowest 0.1 Because of the high absorption, the drug was discontinued as early as possible.

Of the ten patients treated with this therapy, one wound failed to show any response. In Case 68 the patient was a fifty-two year old diabetic with an infected amputation stump. The wound showed no response to ten days' treatment with sodium sulfadiazine or to six days'

* Sterilized sulfanilamide buffered with $CaCO_3$ was supplied by Wallace and Tiernan Company.

* The sodium sulfadiazine was supplied by Lederle Laboratories.

Heliogen powder therapy. All treatment was discontinued.

Two wounds (Cases 72 and 88) showed marked improvement with sodium sulfadiazine which was discontinued because of its high absorption since it was expected that healing would continue with dry dressings or with Ringer's solution. Both wounds remained static and Heliogen was substituted and continued until healing was complete.

One wound required surgical revision. In Case 76 an infected appendectomy wound was treated with sodium sulfadiazine for twenty-one days. The patient was referred for surgical revision with the wound clean and in good condition. The highest blood level was 2.26 mg. per cent. The patient was lost to follow-up.

Wounds in the remaining six cases healed completely or showed marked improvement. In the three cases which were followed to complete healing (Cases 80, 92 and 100) the wounds were treated with dry dressings or irrigated with Ringer's solution for periods from two to twenty-five days after discontinuance of sodium sulfadiazine before healing was complete.

In general wounds treated with sodium sulfadiazine progressed rapidly and satisfactorily and the results of this therapy far surpassed those from the buffered sulfanilamide. There was no evidence of drug reaction or local irritation in the ten patients treated. The patients complained of a moderate burning sensation lasting about fifteen minutes after application.

Sodium Sulfate Soaks. The wounds were treated with continuous wet dressings of a saturated solution of sodium sulphate. A thin strip of vaseline gauze was placed immediately over the wound and the wet dressing was applied every twenty-four hours. Additional protective coverings were employed to keep the dressings moist.

In this group of ten cases one patient expired. Case 78 was a fifty year old diabetic with a chronic undermining ulcer of two months' duration. After eight days of sodium sulfate therapy healing was progressing rapidly when the patient died from heart failure.

One case showed an extension of the decubitus ulcer after initial improvement. The patient in Case 66 was a sixty-seven year old diabetic with a decubitus ulcer of the sacral region and a superficially infected amputation stump. After nine days of sodium sulfate therapy the decubitus ulcer began to fill in with healthy granulations and then extension began. Heliogen irrigations and powder were used for seven days but the ulcer continued to spread although Pseudomonas aeruginosa disappeared the fifth day. The stump was irrigated for twelve days with Lugol's solution, with slight improvement. Treatment was changed to Heliogen irrigations for six days but the wound continued to discharge. All therapy was discontinued and the patient was discharged.

In one instance additional surgery was required. The patient (Case 74) had a breast abscess which was 9 cm. deep. After seventeen days of sodium sulfate therapy the wound was 50 per cent healed but showed need for further surgery. The patient was referred for the operation and lost to follow-up.

One patient (Case 90) showed improvement under sodium sulfate but the granulations appeared boggy. They became healthy under Heliogen irrigations and the wound decreased about 50 per cent. The patient was referred for secondary closure. Wounds in the remaining six cases healed completely or showed marked improvement.

In deep wounds such as those in Cases 74 and 82 there was particular success in filling the cavity with granulating tissue. However, in shallow, clean wounds as in Cases 86 and 93 granulating areas level with the surface seemed to progress slowly. In three instances (Cases 86, 90, and 70) there was evidence of excessive or abnormal granulations. One case (90) of skin irritation was observed. A moderate burning sensation was experienced for fifteen to twenty minutes following the application

of the first pack. This dressing is not always practical or convenient; in certain parts of the body it is impossible to maintain adequate coverage without considerable discomfort to the patient.

Heliogen Powder. The Heliogen powder used for dry application has a lower iodine concentration than the preparation used in irrigating wounds. The concentration of iodine was chosen on the basis of toxicity tests and the results of *in vitro* tests in which no coagulation of protein occurred. This concentration was shown to be bactericidal. The powder is readily soluble in body fluids and does not cake in the wounds. If, however, the lesion is too dry to dissolve all of the powder, it forms a protective film under which healing can proceed. The bactericidal efficiency of Heliogen is not greatly diminished in the presence of organic material.

Of the ten cases in this group, two patients expired with no appreciable improvement in the wounds. Case 44 was a grossly infected abscess of the abdominal wall. The patient remained comatose or semi-comatose following the operation and expired the thirteenth postoperative day with the wound slightly improved. The patient in Case 101 was a seventy-three year old diabetic with a gangrenous appendix. The postoperative wound was treated with Heliogen powder. On two occasions following operation there was temporary paralysis of the right leg. The patient expired on the fourteenth postoperative day from a cerebral accident with no essential improvement in the wound.

In one instance (Case 97) Heliogen was replaced in an effort to eliminate persistent organisms but the original therapy was resumed. Although the wound was contracting rapidly, the organisms persisted and Heliogen powder was replaced by buffered sulfanilamide. The organisms were eliminated but in three days a severe drug reaction developed and Heliogen powder therapy was resumed. The wound proved to need additional drainage and the patient was referred for the necessary surgery and was lost to follow-up.

The other seven wounds healed completely or showed marked progress with Heliogen powder therapy. One of these cases presented a particularly difficult problem. In Case 65 the patient was eighty years old and had diabetes mellitus and arteriosclerotic heart disease. Following an umbilical herniorrhophy the wound became infected with hemolytic staphylococcus aureus. Although the patient's general condition deteriorated, culminating in death, the wound had healed completely under Heliogen powder therapy.

In general the wounds cleared rapidly and progressed satisfactorily with Heliogen powder treatments. In none of the cases in which patients were treated with Heliogen powder was there any evidence of systemic toxicity. One patient (Case 73) showed skin irritation which was possibly but not certainly due to Heliogen. Most patients complained of a moderate burning sensation for about fifteen minutes following application.

SUMMARY OF SERIES III

1. Buffered sulfanilamide did not evoke as favorable a response as was hoped. Six cases out of ten were transferred to other forms of therapy to hasten healing.
2. Wounds treated with sodium sulfadiazine healed rapidly in most instances. Because of the high absorption the drug was discontinued as early as possible.
3. Sodium sulfate soaks showed particular success in filling deep wounds with granulations but wounds level with the surface progressed more slowly. Dressings are subject to greater practical difficulties than powders or irrigations.
4. With Heliogen powder most wounds cleared rapidly and responded very satisfactorily.

CHANGES OF THERAPY

A study of the number of substitutions necessary for each therapeutic agent and the progress of the wounds under other treatments may give an indication of the

relative values of the different substances used.

Heliogen therapy was the one usually employed when a substitution was made in any case in which the wound was originally treated with another agent. There were three cases in which a preparation other than Heliogen was used as the replacing therapy. In Case 44, the ulcer treated with aqueous iodine became worse so the patient was discharged on gelatine paste boot and subsequently improved. In Case 27 azochloramid cleaned the wound but because of severe pain the treatment was changed to normal saline. Complete healing followed. The wound in Case 47 showed only slight improvement with azochloramid but healed completely with hot Sitz baths.

Although Heliogen was substituted for saline and peroxide in Case 42, this was not evaluated because the patient's failure to cooperate made further treatments futile. Case 35 was not significant because although Heliogen was substituted for azochloramid for a single day during the course of treatment, the original therapy was immediately resumed.

In order to evaluate the data more accurately we are summarizing the clinical records of these substitution cases beginning with those preparations which appeared less effective.

Compound Solution of Iodine. Heliogen therapy replaced the aqueous iodine irrigations in four of ten cases. However, the wound in Case 60 had inadequate drainage and the patient's condition precluded operation.

In Case 40 with daily foot soaks in diluted Lugol's solution for nine days there was improvement in the swelling but none in the discharge. After daily Heliogen foot soaks were started, the swelling and discharge decreased rapidly. Remnants of the nails which acted as foreign bodies prevented complete healing. The necessary surgery was performed and subsequently complete healing occurred under Heliogen therapy. It should be noted that improvement began under Heliogen treatments before the removal of the nail remnants. In Case 32 the wound was treated with Lugol's solution for forty-seven days but did not appear to be making any more progress. Heliogen therapy was begun and the wound healed uneventfully twelve days later. In Case 56 the wound was irrigated with Lugol's solution, full strength, for three days and then with half strength for six days. Heliogen treatments were started because there was no formation of new granulations. In three days the wound was much cleaner but five days later the case was lost to follow-up. In the three preceding cases one wound healed and two improved after the change to Heliogen irrigations.

Azochloramid. Heliogen was substituted for azochloramid in four of ten cases. However, in Case 43 osteomyelitis was found deep in the pelvis.

In Case 39 a recurrent superficial ulcer had not progressed with wet soaks, gentian violet and scarlet ointment during three months. After admission to the series practically no progress occurred in one week of daily irrigations with azochloramid but under Heliogen irrigations the wound healed completely in twenty-two days. The wound in Case 55 was packed with sulfathiazole for two days after excision of a carbuncle. During six days of subsequent azochloramid therapy there was no improvement so Heliogen irrigations were started. In twelve days the wound had decreased from 8 to 6½ cm. and the granulations were clear and appeared healthy. In Case 51 the wound was an atrophic type of ulcer, recurrent over fifty years on a sixty-nine year old patient. This lesion had increased in size over a period of two to three years under treatment with gentian violet and boric acid salve. After three days of azochloramid therapy the wound seemed worse, but with Heliogen irrigations (sixty-eight days) the base of the ulcer filled in with bright pink granulations. While epithelium did not grow, a successful skin graft was accomplished. Of the three preceding cases two wounds

healed completely and one showed marked progress after Heliogen therapy was begun.

Buffered Sulfanilamide. Six of ten cases were changed to Heliogen therapy from buffered sulfanilamide. However, one case was inconclusive (Case 67). Several therapies including sulfanilamide, sulfadiazine and Heliogen were tried; but although the wound appeared clean, it did not progress. Improvement occurred when the wound was disturbed only once in four or five days for Heliogen irrigations followed by Heliogen powder.

In two instances (Cases 79 and 83) wounds which had been slow or stationary in forming granulations or epithelium under buffered sulfanilamide progressed satisfactorily under Heliogen therapy. In Case 79 after fifteen days of buffered sulfanilamide, eight days of dry dressings and six days of sulfanilamide, a small portion of the granulating area had still failed to epithelize. Heliogen irrigations were started and in seventeen days healing was complete. In Case 83 after twenty-two days of buffered sulfanilamide treatments and six days of dry dressings a small opening in the granulations had failed to fill in. Heliogen powder therapy was started and in ten days healing was complete.

In three cases the wounds progressed under Heliogen therapy whereas they had not materially improved under buffered sulfanilamide. The superficial decubitus ulcer in Case 63 showed some progress after nine days' treatment with buffered sulfanilamide but because improvement was not considered satisfactory, sodium sulfadiazine was started. A rash developed, probably a delayed reaction to sulfanilamide. Heliogen irrigations were begun and after nine days the wound was 25 per cent smaller. In Case 87 the wound, 7 cm. deep and 1 cm. in diameter, had decreased a maximum of 25 per cent during ten days' treatment with sulfanilamide. In fourteen days of Heliogen therapy which followed, the wound healed completely. The wound in Case 95 still had a profuse yellow-brown discharge and only a few small areas showed the formation of granulations after eleven days of buffered sulfanilamide. Heliogen irrigations were started. In seven days the discharge was considerably less and in a total of thirty-three days of Heliogen therapy the wound had decreased in size 75 per cent. Of the five preceding cases one healed completely, two improved, one wound formed granulations and one formed epithelium under Heliogen treatments.

Sodium Sulfadiazine. Of the ten cases in this group three patients were transferred to Heliogen therapy. However, in Case 68 the wound was an infected mid-thigh amputation stump on a fifty-two year old diabetic. No progress occurred with either therapy.

In Case 72 the wound was treated with sodium sulfadiazine and was so improved after sixteen days that the drug was discontinued (because of its high absorption) in favor of irrigations with Ringer's solution and dry dressings. Fourteen days later, however, satisfactory progress had not been maintained and Heliogen irrigations were started. While the wound healed completely under Heliogen therapy, progress has also occurred with sodium sulfadiazine. Case 88 followed a similar course. Under sodium sulfadiazine therapy the wound contracted 40 per cent in nine days when the drug was discontinued because of its high absorption. Ringer's solution irrigations and dry dressings were used for ten days but the wound remained the same. Heliogen powder applications were begun and in eight days the wound was 80 per cent healed. Fourteen days later healing was complete on daily hot baths. As in the preceding case the wound improved under both Heliogen powder and sodium sulfadiazine. Of the three cases changed from sodium sulfadiazine to Heliogen therapy, one wound did not improve with either treatment and two wounds progressed under both preparations.

Saturated Sodium Sulfate. Of the ten patients treated with saturated sodium sulfate, two were transferred to Heliogen

therapy. However, in one of these (Case 66) an elderly diabetic with arteriosclerotic heart disease, an infected amputation stump and a decubitus ulcer of the back offered an extremely poor prognosis regardless of the type of treatment.

In Case 90 the wound was first treated with saline and peroxide for eight days with no improvement. After twelve days of sodium sulfate soaks granulations were beginning to fill in but appeared boggy, the wound was still discharging a purulent exudate and the adjacent skin showed evidence of marked irritation. After seven days of Heliogen irrigations the granulations were more satisfactory in appearance; ten days later epithelization was progressing. The patient was discharged on dry dressings and was re-admitted one week later for a secondary closure as the wound had not progressed further on dry dressings. In the preceding case the wound improved under Heliogen therapy whereas progress under sodium sulfate soaks had not been satisfactory.

Heliogen Solution. Of the twenty-three patients treated with Heliogen irrigations (thirteen in the preliminary series and ten in Series II) only one (Case 20) was changed to another therapy. However, in this case the patient was sixty-four years old and her condition was complicated with anemia of undetermined nature and uterine fibromyomas. The wound was a huge, discharging ulcer of the back of three years' duration. The spinal processes of the lumbar vertebrae were involved. The lesion was treated with Heliogen irrigations, then with saline and peroxide irrigations in conjunction with sulfanilamide and again with Heliogen. No essential progress was noted with any therapy. The patient was discharged on her own request.

Heliogen Powder. Of the ten patients treated with Heliogen powder, one (Case 97) was transferred to other therapy. In this case the wound was treated with Heliogen powder for twenty-five days. The wound contracted rapidly but the organisms persisted and treatment was changed to buffered sulfanilamide. The organisms were no longer recovered but the patient showed a strong drug reaction and Heliogen was resumed. Hemolytic streptococcus was again cultured. The wound proved to need additional drainage; the patient was referred for the necessary surgery and was lost to follow-up.

SUMMARY OF CHANGES OF THERAPY

An examination of the changes in therapy brings out four points:

1. Of the nineteen cases in which Heliogen replaced the original therapy, fifteen patients progressed under Heliogen treatments. In the remaining four cases improvement was not observed with either therapy.

2. Of the forty-one patients treated with Heliogen, change of therapy was considered advisable in only two cases. In both instances they failed to improve after substitution. This group of cases includes Series I in which there was a larger proportion of chronically infected wounds and of advanced adverse systemic conditions.

3. With four of the eight therapeutic agents used, wound progress was sufficiently satisfactory in all or nearly all of the cases so that change of therapy was unnecessary. These agents were saline and peroxide, saturated sodium sulfate, sodium sulfadiazine and Heliogen, in both solution and powder form.

4. The data indicate that three of the substances used appeared to be less effective than the others. These were compound solution of iodine, azochloramid and buffered sulfanilamide.

COMPARISON OF RESULTS

We are cognizant of the inherent difficulties peculiar to any clinical investigation, some of which are as follows: (1) A particular wound might have progressed more rapidly under some other therapy than the one originally tried. (2) When a change of therapy results in better progress, the improvement cannot be at-

tributed with certainty to the effect of the new treatment because the change itself may stimulate the natural restorative processes. (3) Some wounds may be expected to heal completely without any local therapy whatsoever. (4) There are variables associated with any clinical study such as the differences in the area and depth of wounds, the variations in degree and nature of the infections and in the ages and systemic conditions of the patients. (5) From the data it can be seen that there was great variation in the bacterial flora of the wounds. Only two organisms were cultured in the majority of cases. Hemolytic staphylococcus aureus and hemolytic streptococcus.

However, even with these organisms two factors lead us to believe that it is not helpful to compare the elimination of bacteria under different therapeutic agents with respect either to the number of times they were eliminated or the number of days required for elimination. These factors are (1) the relatively small number of patients treated with any one therapeutic agent and (2) the variables in the wounds and in the systemic conditions of the patients. Unless comparison can be made between wounds of at least approximately the same size and type, infected to the same degree with the same organisms, and unless the patients' systemic conditions are comparable, the elimination of organisms is obviously an unfair basis of comparison. These conditions were not present in this study.

Because the conditions of this study precluded a significantly accurate count, no quantitative study of the bacterial flora of wound surfaces was made. Present methods of taking bacterial counts from wound surfaces give at best only an approximation of the number of organisms present. In addition, no technic is available for the quantitative estimation of bacteria deep within tissues; our clinical cases involved a number of such wounds.

For the reasons outlined we have not used the elimination of bacteria as one of the criteria in attempting to evaluate the relative efficacies of the substances used in treatments.

The relatively small number of cases included in this study precludes the statistical evaluation of the results in such a way that the effect of uncontrollable variables would be reduced to a minimum. Accordingly, the conclusions drawn from this investigation cannot be taken as absolute or final but we believe there is sufficient evidence as to the merits of the preparations studied to warrant presenting the comparisons and conclusions as indications of what may be expected.

The relative values of the different therapeutic agents with respect to the progress of the wounds and the toxicity are listed. Comparisons are made only between Heliogen and the other preparations used. When both substances have the same property to a like degree, this is omitted from the comparisons.

Aqueous Iodine. Wound progress with Heliogen irrigations appeared to be more satisfactory than with compound solution of iodine. With aqueous iodine one patient of ten showed skin irritation while none of the twenty-three patients treated with Heliogen solution gave evidence of any toxicity.

Azochloramid. Healing with Heliogen irrigation therapy was more satisfactory than with azochloramid. In addition, three patients of ten showed local toxicity under azochloramid treatments while none of the twenty-three patients on whom Heliogen was used showed any toxicity. This is more noteworthy as some exceptionally difficult wounds in the Heliogen group required treatment for long periods of time.

Saline and Peroxide. Wound progress was satisfactory with both saline and peroxide and with Heliogen irrigations although with saline and peroxide wound healing was generally slow; four patients of ten required additional treatment such as saline irrigations to make the wound heal completely. Heliogen solution is bactericidal while treatment with saline and peroxide is only slightly inhibitory.

Buffered Sulfanilamide. The progress of wounds appeared to be much more satisfactory under Heliogen therapy than with this particular buffered sulfanilamide. One patient of ten showed a drug reaction to sulfonamide and one patient of ten showed skin irritation possibly due to Heliogen.

Sodium Sulfadiazine. With both sodium sulfadiazine and Heliogen powder wound progress was very satisfactory. It would be difficult to choose either preparation to the exclusion of the other. Under sodium sulfadiazine therapy there is an ever-present possibility of a drug reaction so that blood levels and kidney function must be constantly watched.[4,5] Heliogen powder appears to be without danger of systemic toxicity although in one patient of ten there was a skin irritation possibly due to Heliogen.

Sodium Sulfate Soaks. Progress of deep wounds seemed to be equally satisfactory with Heliogen and with sodium sulfate soaks up to the point when epithelium began to form. Shallow wounds progressed more satisfactorily with Heliogen. The sodium sulfate dressing is not always practical and in some parts of the body can be used only with considerable discomfort. Heliogen powder therapy is without this disadvantage. Sodium sulfate is neither bacteriostatic nor bactericidal while Heliogen is bactericidal.

CONCLUSIONS

In so far as results can be evaluated from the limited number of cases, it appears that (1) Heliogen, under the conditions used in this study, is not toxic, (2) it is successful in clearing up the odor and discharge of infected wounds with free drainage; and (3) wounds, including those chronically infected which had remained static under various therapies, responded favorably to Heliogen.

We suggest that Heliogen may prove to be a valuable addition to the chemotherapeutic agents used in the treatment of wounds.

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PRIMARY RESECTION AND ASEPTIC ANASTOMOSIS FOR LESIONS OF THE COLON*

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AFTER resecting lesions of the colon the surgeon may immediately re-establish bowel continuity or may elect to delay the anastomosis using some modification of the Mikulicz procedure. Primary resection of lesions of the colon and aseptic anastomosis have become increasingly popular in the last few years. This is due to a number of factors among which are: greater use of the Wangensteen and Miller-Abbott tubes, development of antibiotics and colon antiseptics, better knowledge of the preoperative preparation of patients, refinements in anesthesia and surgical technic and use of blood and plasma. Increasing familiarity with the procedure has added to its safety. Other less scientific reasons for doing primary resections are: avoidance of multiple operations and decrease in hospital days. These, of course, only become important if the safety of the procedure is established.

There is common agreement among surgeons that primary resection offers wide removal of the lesion and its mesentery in addition to the advantages just mentioned. For a long period of time primary intraperitoneal anastomosis of the colon was avoided because it was dangerous. The earliest attempts to treat carcinoma of the colon surgically were crude attempts at resection and immediate anastomosis—usually open. With no preparation, usually in the face of obstruction, with debilitated patients and without antibiotics and other surgical adjuvants, the results were disastrous. As Wangensteen[14] points out surgery was not yet ready for primary resection. With the development of the exteriorization principle by Mikulicz and others, the subsequent drop in mortality figures followed. Because of the inauspicious start made by primary resection and anastomosis, there has been an understandable reluctance on the part of surgeons to accept this procedure. It is our purpose in this paper to report briefly our experiences with primary resection and aseptic anastomoses of the colon.

PREOPERATIVE PREPARATION

Preoperative treatment of the patients in this series might properly be considered under three headings: (1) General considerations; (2) management of the unobstructed case and (3) management of the obstructed case.

General Considerations. Many of these patients exhibited chemical imbalances, vitamin deficiencies, anemias and hypoproteinemia. Efforts were concentrated on correcting these states by use of whole blood transfusions, vitamins, liberal high protein diets and parenteral fluids including amino acids when indicated. Wherever and whenever possible the patients were kept ambulatory until just before definitive surgery was done.

Management of the Unobstructed Case. These patients were placed on a high caloric, high vitamin, high protein, low residue diet. The colon was prepared using daily enemas and saline catharsis with Fleet's Phospho-Soda, 2 dr. at 9 and 11 A.M. They were started on sulfasuxidine with an initial dose of 3 to 4 Gm. and then 2 Gm. every four hours. We found that with seven to ten days of such preparation the colon was bacteriologically and physically ready for surgery. Many surgeons prefer to use sulfathalidine as a colon antiseptic and there is little question that it is equally

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as effective as sulfasuxidine. On occasion, sulfasuxidine will cause mild to moderate diarrhea but we have never encountered a reaction severe enough to cause us to discontinue it. Indeed we believe that this mild diarrheic effect is advantageous and helps in the preparation of the colon. We believe that the actual mechanical cleansing of the colon is more important than use of the colon antiseptics. Much of this portion of the preoperative management of these patients was carried out on an ambulatory basis outside of the hospital.

Management of the Obstructed Case. Obstruction of the colon from right-sided malignant lesions is rarely encountered. This is due to the larger diameter of the right colon, its liquid contents and the nature of the growth. When obstruction of the right colon does exist, it is of serious prognostic import, usually denoting incurability because of marked local extension or widespread metastases. Often decompression can be accomplished by use of the Miller-Abbott tube followed later by low enemas. If after a reasonable trial the obstruction is not relieved, then ileotransverse colostomy is the procedure of choice. After the ileotransverse colostomy has been done the usual preparation is begun and if possible the resection is done as a second stage.

With obstruction in the transverse or descending colon, we prefer cecostomy, using a large bore tube and the technic of Lockhart-Mummery.[8] In our experience this procedure has proved to be most satisfactory. The size of the lumen of this tube is very important and we have found that a tube with a lumen diameter measuring 0.75 cm. is ideal. We find that it furnishes adequate, immediate, safe decompression and the fistula closes rapidly once the tube is removed. We irrigate the cecostomy tube with tepid water daily, beginning irrigations in about forty-eight hours. We have, on occasion, used a saturated solution of sulfasuxidine instilling it through the tube following irrigation. Often the edema about the lesion subsides and the obstruction is relieved enough to allow the irrigation to pass per rectum. We have found the average obstructed case requiring cecostomy will need from ten to fourteen days to decompress adequately the colon and condition the patient for further definitive surgery. The cecostomy does not and should not prevent ambulation before the final procedure. There are many who advocate the use of transverse colostomy in this situation and we certainly have no quarrel with them. However, the patient is then committed to another operative procedure.

TABLE 1

Nature of Lesions	No. of Cases	Deaths
Carcinoma	38	0
Ileocecitis	4	0
Lymposarcoma of the cecum	1	0
Tuberculosis of the cecum	1	0
Carcinoid of the terminal ileum	1	0
Lipoma of the cecum	1	0
Diverticulitis of the cecum	1	0
Carcinoid of the transverse colon with jejunocolic fistula	1	0
Total	48	0

All patients with lesions of the cecum or ascending colon come to the operating room with a Miller-Abbott tube in place. Patients with lesions elsewhere in the colon have an inlying gastric tube. For these it has been our policy to do a cecostomy at the time of resection, if one had not already been done, because often the ileocecal valve prevents effective decompression by the Miller-Abbott tube.

NATURE AND LOCATION OF LESIONS

A glance at Table 1 shows that the majority of resections were undertaken for carcinoma. Among the lesions of the right colon there were four cases of ileocecitis in which we elected resection of the terminal ileum and right colon. One patient had tuberculosis of the cecum necessitating resection. One patient had a carcinoid of the terminal ileum with metastases to the liver. The local lesion was resected and the

patient is alive and working every day eighteen months following operation. There was one case of lymphosarcoma and one lipoma of the cecum. One patient, an eighty-seven year old male, was operated on for acute appendicitis and was found to have a mass involving the cecum but not the appendix. This was resected without preparation under the impression we were dealing with a carcinoma. Pathologically it proved to be a large diverticulum of the cecum. The mass consisted of dense inflammatory tissue surrounding the fecalith-filled diverticulum. This patient made a remarkable recovery. He was discharged as ambulatory from the hospital on his eighth postoperative day. There were no deaths in this series.

TABLE II

Location of the Lesions	No. of Cases
Cecum and ascending colon	25
Transverse colon	6
Splenic flexure	7
Descending colon	4
Sigmoid colon	6
Total	48

A study of Table II reveals that the majority of lesions for which aseptic anastomosis was done were proximal to the sigmoid colon. In our opinion this technic is not applicable to most lesions of the sigmoid colon because of the difficulty in applying the clamps and of placing sutures accurately deep in the pelvis. In those lesions of the sigmoid colon which are high enough for anterior resection but too low for the use of this technic we have used open anastomosis with good results.

TYPES OF OPERATIONS

It will be seen from Table III that twelve one-stage resections of the cecum and ascending colon with complementary ileostomy were done. These were done early in the series. Since then we have done thirteen similar resections without ileostomy but utilizing a Miller-Abbott tube. We believe that an ileostomy is unnecessary with a Miller-Abbott tube in place and functioning.

In seven cases of unrelieved obstruction it was necessary to do a preliminary cecostomy as a first-stage procedure followed at a later date by resection and anastomosis.

TABLE III

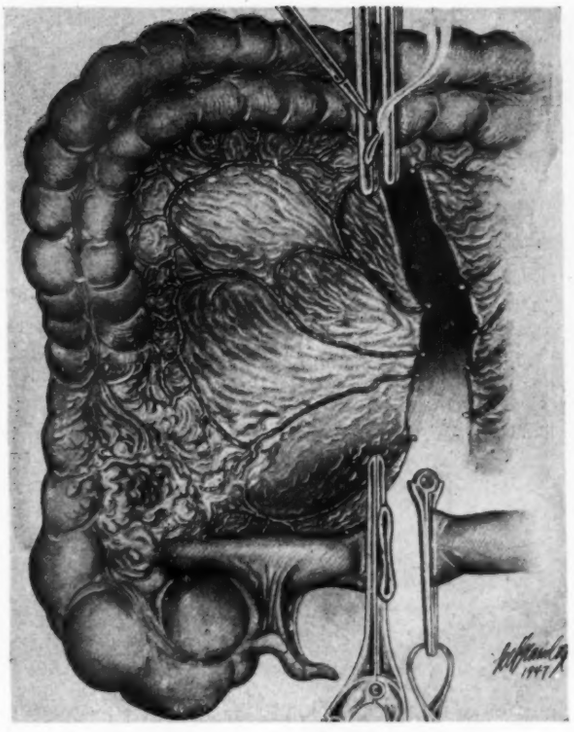
Types of Operations	No. of Cases
One-stage resection of the cecum and ascending colon with ileostomy	12
One-stage resection of the cecum and ascending colon without ileostomy	13
One-stage resection of the transverse colon with cecostomy	4
One-stage resection of the transverse colon without cecostomy	2
One-stage resection of the splenic flexure with cecostomy	3
Two-stage resection of the splenic flexure with cecostomy, first-stage	4
One-stage resection of the descending colon with cecostomy	4
One-stage resection of the sigmoid colon with cecostomy	3
Two-stage resection of the sigmoid, cecostomy, first-stage	3
Total	48

It will be seen from Table III that in resection of the transverse, descending and sigmoid colon we have done a complementary cecostomy at the time of operation. We believe that this is a safety measure of merit.

COMPLICATIONS

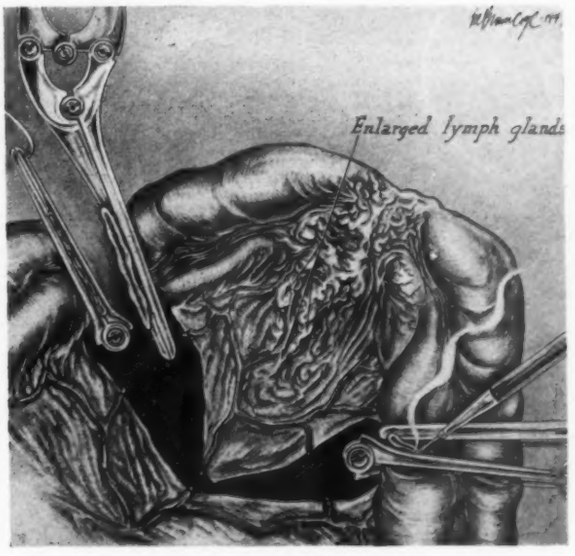
It was necessary to reoperate upon one patient because of obstruction at the site of the anastomosis. It has been our practice to break in the mucosal diaphragm with the index finger and thumb following completion of the anastomosis. In this case the crushed mucosa had remained sealed and at the second operation an incision was made over the anastomosis longitudually, the septum was opened and the bowel was closed transversely. The patient made a prompt recovery.

There were four intrabdominal abscesses occurring postoperatively which we believe definitely can be attributed to some technical error resulting in a leak of colonic contents. (Table IV.) All four of these patients developed septic fevers with palpa-



1A*

FIG. 1. A, shows removal of the primary lesion and the gland-bearing mesentery.



1B†

FIG. 1. B, removal of the primary tumor with the gland-bearing mesentery; blood vessels have been tied.

ble, tender, abdominal masses. All were adipose with fat mesenteries, and all instances occurred in resections of the right colon. It was necessary in one case to drain two abscesses through the abdominal wall. The other three patients ran remarkably similar courses. Each ran a septic fever with a palpable non-pointing intra-abdominal mass. Subsequently, each had several very loose, foul stools containing pus, following which their temperatures rapidly returned to normal and the masses disappeared. Three of these patients had both penicillin and sulfadiazine postoperatively. One patient had neither and ran essentially the same course. There was one wound dehiscence in this series.

TABLE IV

Complications	No. of Cases
Intra-abdominal abscess	4
Obstruction at the site of the anastomosis	1
Wound infection at the site of the ileostomy	1
Wound infection at the site of the cecostomy wound	1
Wound infection	1
Cystitis	4
Pneumonia	1
Wound dehiscence	1

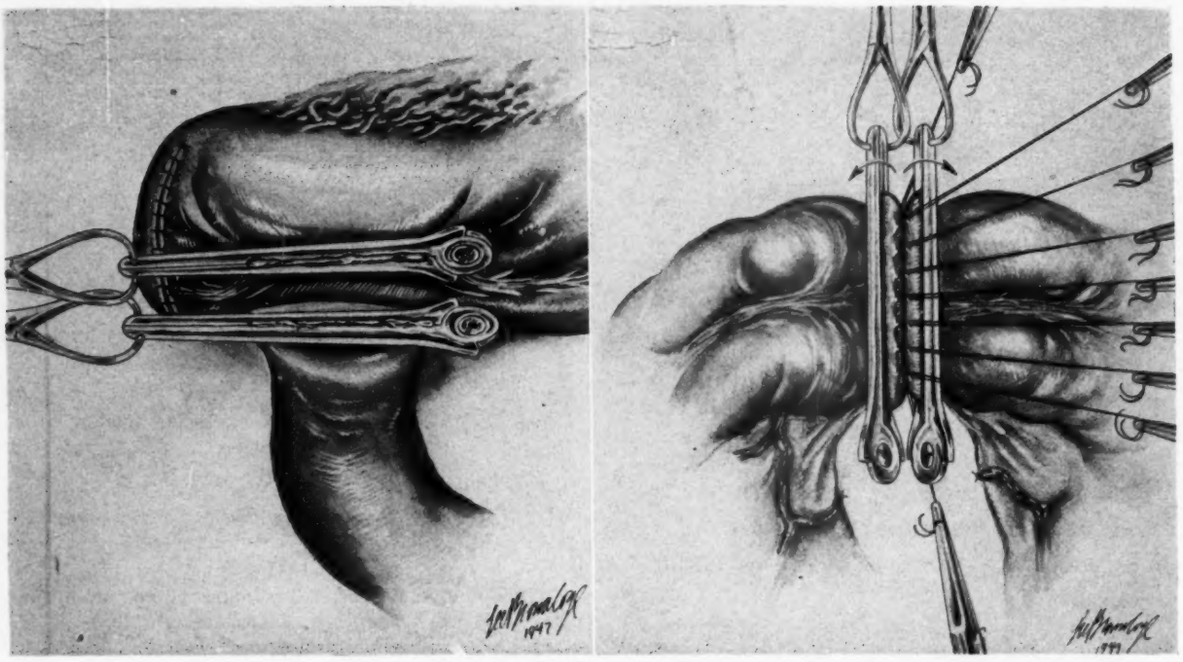
The other complications were of a minor nature. We had no thrombophlebitis or recognized phlebothrombosis in this series although the average age was fifty-five years.

POSTOPERATIVE CARE

At the time of operation all patients were given whole blood transfusions. All patients received blood postoperatively when needed. Most patients were placed in oxygen immediately after operation. Fluid balance was maintained using intravenous fluids. Plasma proteins were maintained as well as possible, using whole blood, plasma and parenteral amino acids. A particular effort was made to prevent postoperative pulmonary complications. The patients were moved frequently and encouraged to breathe deeply and to cough when necessary. In addition, at the first evidence of mucous in the air ways which the patient was unable to expectorate, we used intra-

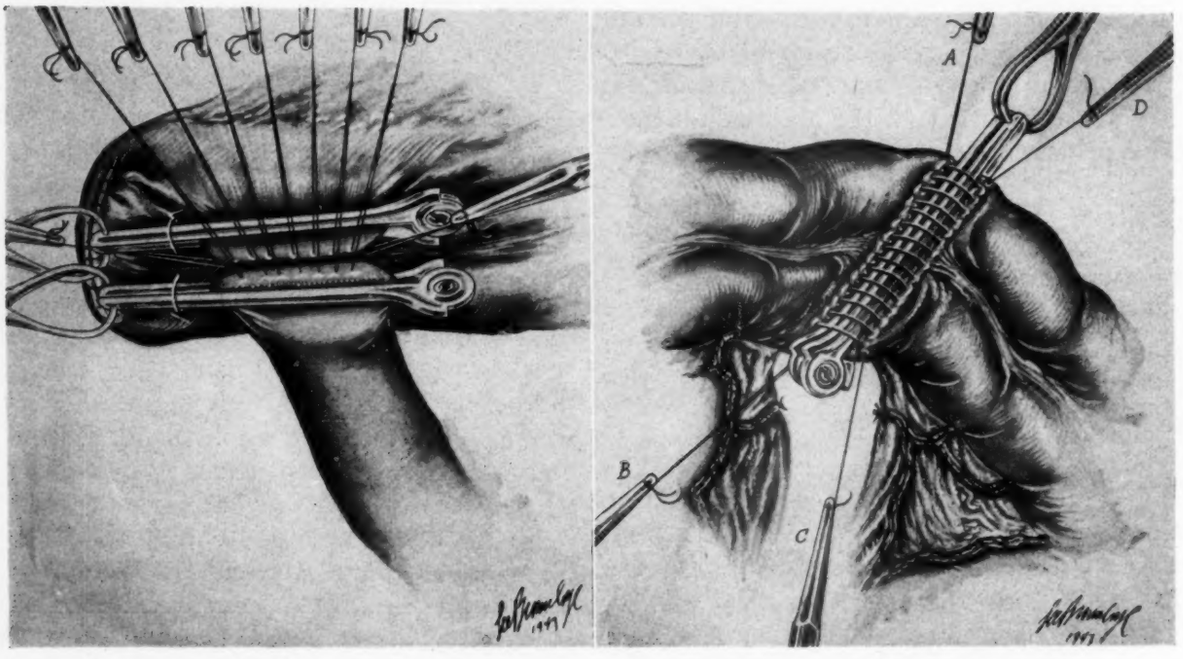
* Figs. 1A, 2A, 3A, 4A and 5A show the procedure for lesions of the right colon.

† Figs. 1B, 2B, 3B, 4B and 5B show procedure for lesions in the transverse, descending and sigmoid colons.



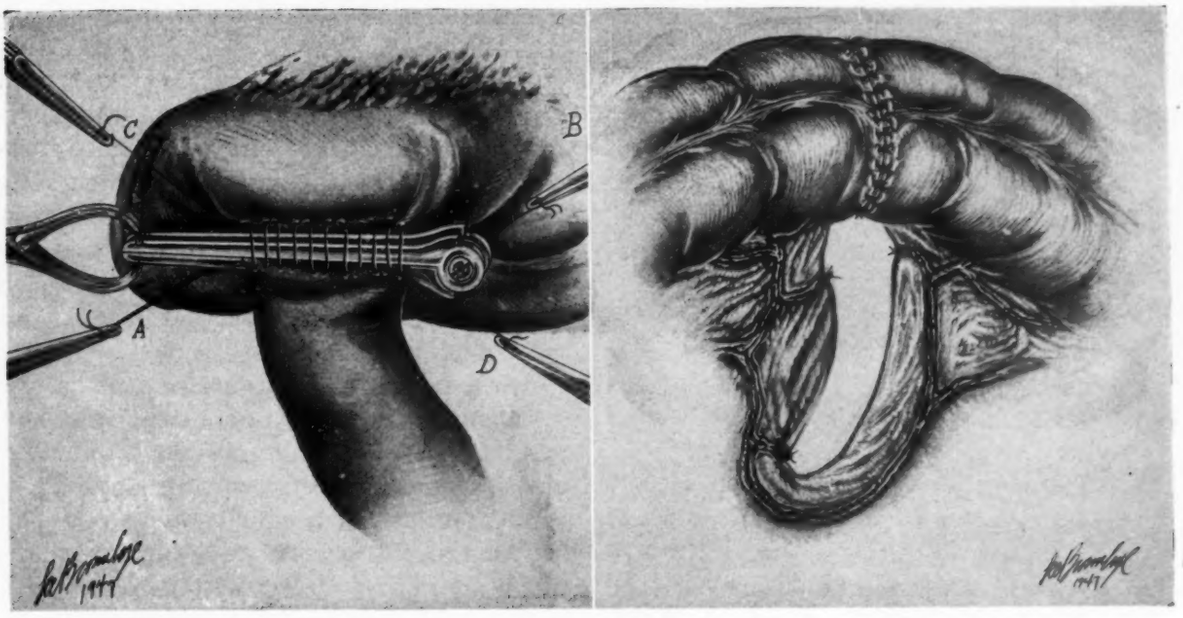
2A 2B

FIG. 2. A, the end of transverse colon has been closed and the portion of transverse colon to be used for anastomosis with ileum has been clamped with a Stone clamp and the bowel wall cut away; B, Stone clamps rotated outward; posterior serosal sutures in place.



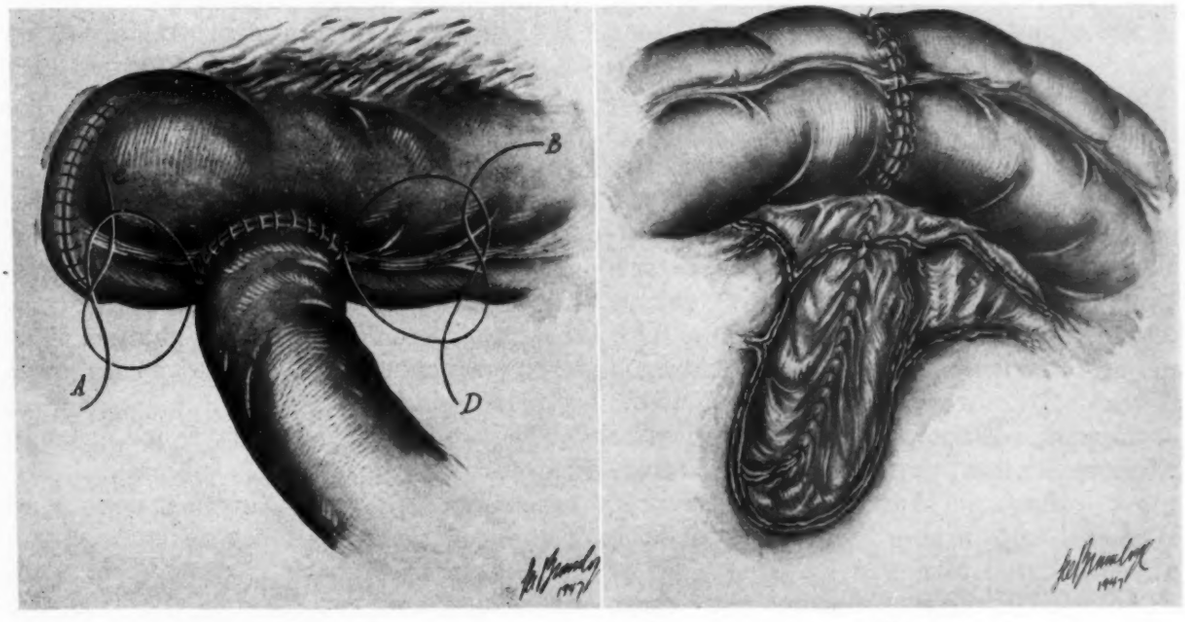
3A 3B

FIG. 3. A, Stone clamps rotated outward and posterior serosal silk sutures in place but not tied; B, running seromuscular basting suture (C and D) of No. oo chromic; end posterior serosal sutures (A and B).



4A 4B

FIG. 4. A, posterior and serosal sutures (A and B); running basting seromuscular suture (C and D) of No. oo chromic which has been taken over the Stone clamps; the clamps are now ready to be removed; B, clamps have been removed; anastomosis is completed and rent in mesentery is to be closed.



5A 5B

FIG. 5. A, shows the clamps removed and the ends of the running chromic suture being tied to the end posterior serosal sutures; B, rent in mesentery closed with sutures of fine silk.

tracheal suction with a soft rubber catheter. Foot exercises were daily routine.

Since the advent of penicillin we have used it routinely postoperatively for the first forty-eight to seventy-two hours. We believe that it will reduce the numbers and severity of pulmonary and urinary complications.

Intragastric or intra-intestinal suction was maintained until the patient passed gas per rectum. This usually occurred at seventy-two hours. Following this the tube

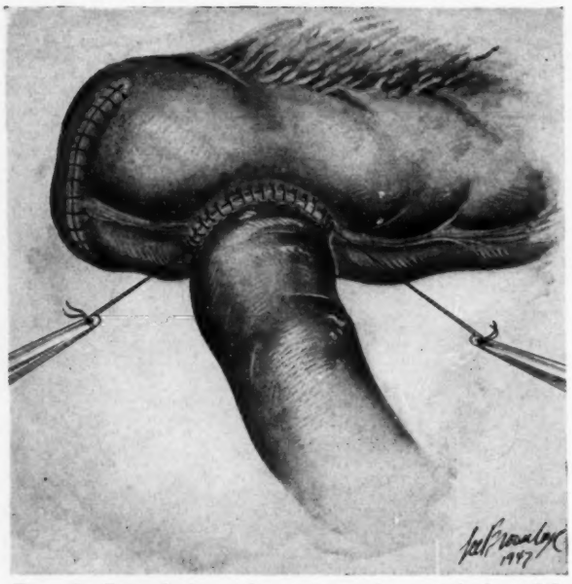


FIG. 6. Completion of anastomosis anteriorly with interrupted serosal sutures of C silk. A similar posterior layer is applied after rotating the bowel.

was removed and the patient started on liquids proceeding as rapidly as possible to a full nourishing diet.

We allowed the patients to be up as soon as was practical. Most of them were ambulatory by the fifth postoperative day. If cecostomy had been done as a first-stage procedure, then the tube was removed after their first normal bowel movement. If the cecostomy was done at the time of operation as a complementary procedure, then the tube was left in place about twelve days before attempting removal. This period of time is needed to allow softening of the catgut sutures so that tearing of the cecal wall will not occur upon removal of the tube. Following its removal, the cecostomy wound quickly closed. The average stay in the hospital of the patient with the uncomplicated case was 15.5 days and of those with complicated cases 34.0 days. The over-all average hospital stay for the patients in this series was 21.6 days.

TECHNIC OF OPERATIVE PROCEDURE FOR LESIONS OF THE RIGHT COLON

The abdomen is opened through a generous right rectus, muscle-splitting incision. Hemostasis is effected with No. 60 cotton ties. Before proceeding with the surgery a complete exploration of the abdominal contents is made. The cecum and ascending colon are mobilized by cutting their lateral peritoneal attachments. The ureter, spermatic or ovarian vessels, kidney and duodenum are visualized and avoided. The ileocolic artery is tied near its origin from the superior mesenteric artery. When the right colic is present and arises from the superior mesenteric artery it is likewise tied. The ileum is then divided with the cautery between Stone and Payr clamps selecting a site about 10 cm. from the ileocecal valve. The transverse colon is divided with the cautery between Stone and Payr clamps, selecting a site well beyond the lesion and, of course, with an adequae- blood supply. A wide portion of the mest entery with the regional lymph nodes is removed with the primary lesion. (Fig. 1A.) The end of the colon is first closed aseptically using a running atraumatic seromuscular suture of No. 00 chromic reinforced with interrupted serosal sutures of C silk. An area on the anterior aspect of the transverse colon near the closed end is then selected and clamped longitudinally with a Stone clamp removing with the cautery a portion of colon approximating the transverse diameter of the ileum. (Fig. 2A.) An aseptic end-to-side ileotransverse colostomy is then done over the Stone clamps. In this series the Stone clamps were used exclusively and proved to be most satisfactory.

The site on the colon is cleaned of fat as carefully as possible and a number of posterior serosal sutures, uniting ileum and colon, are placed but not tied. (Fig. 3A.) When the last stitch is placed, they are then tied and cut leaving the two end sutures long. (Fig. 3A.) A running, basting stitch of No. 00 chromic is then taken over the clamps (Fig. 4A), and while the operator puts gentle traction on the two ends of this suture, the assistant removes the clamps. This procedure inverts the bowel and you are now ready to place the anterior serosal layer. The ends of the chromic basting stitch are then tied into the end pos-

terior serosal stitches (Fig. 5A AC and BD). Inasmuch as the catgut is a running sliding suture, care must be taken at this point not to tie the end sutures too tightly or you will encroach upon the lumen of the bowel. The anterior row of interrupted serosal sutures of C silk are placed and tied. (Fig. 6A.) To reinforce the posterior row and the corners a clamp is passed beneath the anastomosis and the opposite end posterior serosal suture is seized. The bowel is turned by this procedure so that a second layer of posterior serosal sutures of C silk may be taken. The angles are, of course, carefully closed. The anterior layer is reinforced with a few serosal sutures and the rent in the mesentery and mesocolon is closed with a few fine, cautiously placed sutures of C silk.

PROCEDURE FOR LESIONS IN THE TRANSVERSE, DESCENDING AND SIGMOID COLONS

In lesions distal to the hepatic flexure we use end-to-end aseptic anastomosis over Stone clamps. Occasionally, despite preliminary decompression, we encountered moderate disparity in the size of the bowel proximal and distal to the lesion. However, we were able in all cases to perform end-to-end anastomosis. We concede that great disparity between the proximal and distal colon would demand side-to-side anastomosis. The principles of technic are exactly the same as in resection of the right colon described in the preceding paragraph. (Figs. 1B, 2B, 3B, 4B and 5B.)

The wounds are closed with interrupted Snead, figure eight, sutures, using as suture material No. 31 stainless steel wire or No. 40 cotton doubled.

SUMMARY AND CONCLUSIONS*

1. Our experience with forty-eight consecutive primary resections of the colon are presented.

2. We believe that with careful preparation of the patient, including medical or surgical decompression of the bowel, aseptic primary resection of the colon is an adequate and safe procedure.

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* Since this article was submitted for publication, the authors have operated on four additional patients without mortality.

PROGRESS IN COLON SURGERY*

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CONSIDERABLE difference of opinion still exists among the large clinics concerning the operative management of carcinoma of the colon. In 1944 we published the results of our experience with such cases over a five-year period.[1] At that time our procedure of choice in colon resections was the exteriorization operation with delayed anastomosis. It is now ten years since the organization of the surgical gastrointestinal service at the Jewish Hospital of Brooklyn. In the light of surgical progress that has been made since our original report we believe it might be of interest to review again our personal experience with resection of carcinoma of the colon.

It is our purpose in this paper to report upon 115 cases of colon resection for carcinoma (exclusive of carcinoma of the rectum) performed during the years 1938 to 1947, inclusive. For convenience of discussion we have divided this ten-year period into two parts: The early period 1938 to 1944, and the later period 1945 to 1947.

During the seven-year period between 1938 and 1944 a total of sixty-six colon resections for carcinoma were done. Delayed anastomosis was used in fifty-seven instances. The distribution of lesions is noted in Table I. There were fourteen cases of carcinoma of the right colon, thirteen of the transverse colon and thirty left colon lesions. The Lahey modification of the Mikulicz procedure was used in the right colectomies and the transverse and left colon resections were done by the Rankin obstructive method. In this series of fifty-seven cases there were twenty-five wound infections, five eviscerations and four cases of peritonitis. One case of peritonitis was the result of perforation of the cecum preoperatively, the other three occurred following operation. The average hospital stay, in hospital days, in these cases was 68.8 days. This included the time required for closure of the colostomy. Of these 57 patients eight died, a mortality rate of 14.1 per cent. Peritonitis accounted for four of the deaths; one died of postoperative shock; there were two cardiac deaths and one due to a cerebral accident.

During the same seven-year period (1938 to 1944) primary anastomosis was performed in only nine cases. All of these nine cases were right colectomies and five of these were done in two stages. In this group wound infections occurred in eight instances and peritonitis in two. The average hospital stay for these was 50.7 days. This included the two-stage resections. There were three deaths, a mortality of 33.3 per cent. Peritonitis was the cause of death in two cases, a cerebral accident in one. (Table I.)

In the period from 1945 through 1947 a total of forty-nine colectomies were done. Delayed anastomosis was used in only twelve cases and primary anastomosis was performed in thirty-seven. The distribution of cases is indicated in Table II. Of the delayed anastomoses, one resection was of the right colon and eleven were on the left side. In five of the twelve cases there was a significant degree of obstruction due to the lesion, with proximal distention of the bowel. In two cases there was perforation of the lesion with abscess formation at the time of operation. In the remaining five cases the extensive involvement of malignancy, the length of the procedure and the condition of the patient were such as to make delayed anastomosis the method of choice. In these twelve patients in whom delayed anastomosis was

* From the Surgical Department, Long Island College of Medicine and from the Surgical Department, Jewish Hospital of Brooklyn, Brooklyn, N. Y.

done, there was one wound infection, one case of peritonitis and one localized intra-abdominal abscess which drained spontaneously. The average hospital stay for these twelve patients was 43.4 days. There were four deaths in this group, a mortality rate of 33.3 per cent. One death was the result of peritonitis; one was due to postoperative shock; a third fatality was due to cardiac failure and cerebral embolism; the remaining death occurred suddenly on the second postoperative day and was probably due either to coronary occlusion or a pulmonary embolus.

TABLE I
COLON RESECTIONS 1938 TO 1944

	Total Cases	Right Colon	Transverse Colon	Left Colon	Wound Infections	Eviscerations	Peritonitis	Average Hospital Stay (days)	Mortality	
									No.	Per Cent
Delayed anastomosis.	57	14	13	30	25	5	4	68.8	8	14.1
Primary anastomosis.	9	9	0	0	8	0	2	50.7	3	33.3

Primary anastomosis was performed in thirty-seven cases of large bowel resection for carcinoma during the 1945 to 1947 period. There were nine right colectomies, four transverse colectomies and twenty-four resections of the left colon. In this group there were two instances of wound infection, three cases of peritonitis and a localized intra-abdominal abscess occurred on two occasions. Two of the cases of peritonitis were due to preoperative perforation of the carcinomatous lesion with leakage into the peritoneal cavity. Both of these patients died, and in retrospect it appears that primary anastomosis was contraindicated in each instance. The third case of peritonitis occurred following operation as a consequence of edema and obstruction of the operative stoma and resulting perforation of the cecum. This patient also died. Of the two cases of localized intra-abdominal abscess, one was due to perforation of the carcinoma and abscess formation preoperatively and one was the result of leakage at the line of anastomosis. Of the entire group of thirty-seven cases of resection with primary anastomosis, the latter case was the only instance in which there was evidence of leakage at the anastomatic suture line. In this case the abscess was drained and the patient recovered. The average hospital stay of this group of cases was 22.8 days. There were four deaths in this series, a mortality rate of 10.8 per cent. Three of the four fatalities were the result of peritonitis. As indicated above, in two

TABLE II
COLON RESECTIONS 1945 TO 1947

	Total Cases	Right Colon	Transverse Colon	Left Colon	Wound Infections	Evisceerations	Peritonitis	Localized Abscess	Average Hospital Stay (days)	Mortality	
										No.	Per Cent
Delayed anastomosis.	12	1	0	11	1	0	1	1	43.8	4	33.3
Primary anastomosis.	37	9	4	24	2	0	3	2	22.8	4	10.8

of these cases peritonitis was present prior to operation and primary anastomosis was probably ill advised. The fourth death was due to cardiac failure and pulmonary edema.

As can be seen by comparison of the figures in Tables I and II, in each of the anatomic groups of colon carcinoma we have used the procedure of resection with immediate anastomosis as opposed to exteriorization and delayed anastomosis with increasing frequency during the past few years. And this, despite the fact that in recent years our limits of resectability have been extended to the point where only if the bowel is completely frozen or the liver studded with metastases is a palliative operation performed.

Accumulated surgical knowledge of the past decade has been largely responsible for the changes which have made primary anastomosis in colon resections a relatively safe and accepted procedure. This newer surgical knowledge has been incorporated into the details of pre- and postoperative care and operative technic which are of such paramount importance in the ultimate surgical result. It has been on the basis of this newer knowledge that we, as well as others, have more or less standardized our procedure. In the preoperative preparation of the patient for colectomy attention is directed primarily to the correction of anemia, the correction of nutrition and the proper preparation of the large bowel. Transfusions are used liberally to bring the patient's hemoglobin to within normal limits. A high protein, low residue diet, parenteral amino acid solutions and vitamins are used routinely to replenish the nutritive loss that many of these patients have undergone. The preparation of the large bowel is begun by one or two doses of magnesium sulfate, and the bowel is kept clean with daily enemas or colonic irrigations. Sulfasuxidine or sulfathalidine—usually the latter—is given routinely for about five days before operation is contemplated. In acute, complete obstructions preliminary cecostomy or transverse colostomy may be necessary. However, when obstruction is only partial, conservative methods are often adequate to relieve the obstruction and decompress the bowel. If small as well as large bowel distention is present, a Miller-Abbott or Cantor tube is used. Mineral oil is given by mouth, sulfasuxidine is used instead of sulfathalidine since it tends to produce a liquid stool. Colonic irrigations are given daily. Nutrition is supplied by parenteral means in the form of amigen and glucose solutions and the vitamins, B complex, C and K. It is only after the patient's cardiac, pulmonary and renal status have been completely evaluated and after he has received the fullest benefit of preoperative preparation that operation is undertaken.

During the past few years our colectomies have been performed under general, endotracheal anesthesia with cyclopropane and curare. The patient can be maintained under a relatively light plane of anesthesia with a high percentage of oxygen and relaxation of the desired degree can be obtained readily with small doses of curare given intravenously. Blood is given routinely during the operative procedure so that any drop in blood pressure is avoided. Either 500 cc. or 1,000 cc. of blood are given, depending on the length of the procedure and the condition of the patient. Our early primary anastomoses were done with the aseptic closed technic, using the Furniss clamp. However, during the past two years we have used open anastomosis almost exclusively with satisfactory results. Gross contamination will be minimal with a properly prepared bowel, with due care taken to wall off the remainder of the wound from the site of the open bowel and if gloves and wound drapes are changed after the anastomosis is completed. We believe that open anastomosis is more accurate and results in a smaller diaphragm within the lumen of the bowel. Our anastomosis is performed with two rows of interrupted fine silk sutures, an inner layer which passes through the entire bowel wall and an outer seromuscular layer. We have not used complementary colostomy or ileostomy in any of our resections. Since

1945 we have closed all our abdominal wounds with steel wire with very satisfactory results.

Postoperatively nutrition is maintained by the parenteral administration of amigen and vitamins until the patient is able to take an adequate amount of food orally. Nothing is given by mouth for about twenty-four hours after operation. Small amounts of fluids are then allowed orally. Food intake is started and increased as the patient's condition warrants. He is usually eating a fairly adequate diet by the fifth or sixth day. Repeated aspirations of the stomach with the Levine tube during the first few days are usually sufficient to prevent any significant degree of abdominal distention. With the aid of a glycerin suppository the patient will usually have a bowel movement by the fourth or fifth day. The patient is ambulated either in the evening of the day of operation or on the morning of the following day. Sulfathaladine is given routinely after operation. Patients are carefully observed for the possible development of phlebothrombosis. Heparin in Pitkin's menstruum, given subcutaneously, has been used for the treatment of this complication. There have been no fatalities from pulmonary embolism in any of the patients treated by this method. It has been our experience that with careful attention to detail and with the utilization of modern adjuvants which have greatly increased the safety of surgery, that even aged and debilitated patients will withstand extensive operative procedures surprisingly well.

In view of the experience presented we believe that at the present time in the properly selected case, primary anastomosis following colon resection offers the best chance for a favorable outcome. We reserve exteriorization for those patients in whom there is evidence at the time of operation of intestinal obstruction local bowel inflammation and infection or marked fixation of bowel. With immediate anastomosis the morbidity and hospital stay are significantly reduced. In addition, the risk and inconvenience of a second operation and a second anesthetic are avoided. There is a good deal less discomfort to the patient. The incidence of postoperative ventral hernia is less. Often a more extensive and radical resection can be performed by utilizing primary anastomosis since the length of bowel necessary for exteriorization through the abdominal wall is not required. The benefits of immediate as opposed to delayed anastomosis are further reflected in the decreased strain on the patient's mental, physical and financial reserves.

SUMMARY

1. We have reported our experience with 115 colon resections for carcinoma, exclusive of carcinoma of the rectum, during the ten-year period from 1938 to 1947. During the seven-year period from 1938 to 1944 most of our resections were done by some form of exteriorization procedure, with temporary colostomy and delayed anastomosis. Since 1945 we have followed colon resection by primary anastomosis in every case unless there was a contraindication to such procedure.

2. The changing trends in surgery have resulted in an ever increasing number of advocates of primary anastomosis in colon resections. It has been the experience of most workers that primary anastomosis in the selected case is at least equally as safe as any form of exteriorization procedure. In our hands, as a matter of fact, the mortality from exteriorization operations was higher than those following closed resections.

3. Some of the more important details of pre- and postoperative care of the patient with carcinoma of the colon have been briefly outlined and we have discussed some of the features of our operative procedure.

4. Colon resections with immediate anastomosis result in reduced morbidity, decreased hospital stay and in increased comfort and well being of the patient.

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TARDY ULNAR PALSY*

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PANAS[1] in 1878 first described the syndrome that was later to be designated by Hunt[2] as tardy, late or delayed paralysis of the ulnar nerve.

Tardy ulnar palsy is a condition characterized by the insidious onset of paresis or paralysis of the ulnar nerve following months or years of minimal trauma to the nerve adjacent to the elbow. Although this condition is relatively rare, it must be recognized as an important complication of old injuries in this region. Surgical treatment should be instituted promptly after the diagnosis has been made since this is the only satisfactory form of therapy.

At the elbow the ulnar nerve lies directly upon the periosteum in a groove along the posterior aspect of the medial humeral condyle. In this area the nerve is covered only by fascia and skin and is therefore particularly vulnerable to trauma. Tardy ulnar palsy, however, is not the immediate result of an injury to the structures about the elbow: it is, instead, the cumulative effect of repeated minor traumas which finally produce a paralysis of the nerve many months or many years after an initial injury.

Tardy ulnar palsy is most frequently seen as a complication of improperly treated fractures of the lateral humeral condyle. The condylar fragment is displaced proximally and laterally, with a resulting cubitus valgus deformity. Since many of these fractures occur in childhood, the valgus deformity of the elbow usually continues to increase during the growth period. Because the ulnar nerve is forced to traverse a longer route across the elbow, it becomes overstretched when the elbow is flexed. Other conditions which may eventually produce tardy ulnar palsy include the slipping of the nerve over a displaced medial condyle and olecranon, pinching of the nerve between the medial condyle and the olecranon, partial incorporation in callus formation following fracture, adhesions within the ulnar groove preventing the normal mobility of the nerve with movement of the elbow, hypertrophic arthritis, foreign bodies, exostoses, congenital anomalies, recurrent dislocation of the elbow and occupational trauma. Gay and Love[3] found an old fracture of the elbow to be the causative factor in 57 per cent of their cases and arthritis to be the cause in 20 per cent.

The nerve lesion usually associated with tardy ulnar palsy has been designated by Seddon[4] as "axonotmesis." This signifies that there has been damage to nerve fibers so severe that complete peripheral degeneration has resulted, while the sheath and more intimate supporting structures of the nerve have not been completely divided and the mass of nerve tissue remains in continuity. Typical of this type of nerve injury is the so-called "spindle pseudoneuroma" occurring at the point of greatest strain on the nerve. This swelling is the result of an initial rupture of the perineural sheath through which the neural fasciculus herniates under pressure. Whether or not recovery of function will be complete after neurolysis depends largely upon the extent of this herniation and upon the amount of endoneural hemorrhage. In the subsequent process of tissue repair regenerating neural bundles may become so ensnared by the scar tissue as to be non-functional. The pseudoneuroma, once begun, enlarges by the influx of fluid into the endoneural space.

In its course from arm to forearm the ulnar nerve lies in the medial paraolecranon groove and makes its exit from the elbow region by passing between the heads

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of the flexor carpi ulnaris muscle. Usually there are two small motor branches to the flexor carpi ulnaris which arise from the nerve just proximal to the elbow joint. In the forearm the ulnar nerve supplies both the flexor carpi ulnaris and the portion of the flexor digitorum profundus which controls the little and ring fingers. In the hand the ulnar nerve supplies all of the intrinsic musculature except the opponens pollicis, flexor pollicis brevis, abductor pollicis brevis and the first and second lumbrical muscles. Sensory distribution of the ulnar nerve is limited to the medial aspect of the hand, including the entire little finger and the medial half of the ring finger.

In cases of tardy ulnar palsy the degree of nerve injury may vary from slight paresis to nearly complete paralysis. Patients with tardy ulnar palsy usually complain first of paresthesia or hypesthesia in the ulnar sensory distribution. This is followed by increasing weakness or awkwardness in the use of the intrinsic muscles of the hand and finally by paralysis of the muscles supplied by the ulnar nerve. Atrophy of the interossei and the hypothenar muscles may be the most striking feature of the condition. The majority of patients with tardy ulnar palsy demonstrate a tender enlargement of the ulnar nerve in the medial paraolecranon groove; Tinel's sign may be elicited over this enlargement.

Many cases of tardy ulnar palsy could be prevented by proper recognition and early adequate reduction of fractures involving the lateral humeral condyle. Open reduction of these fractures is frequently necessary. In the treatment of injuries to the elbow in children it is most important to compare roentgenograms of the injured elbow with those of the uninjured elbow. A minor displacement of one of the epiphyses about the elbow may thus be diagnosed and proper treatment instituted.

After a tardy ulnar palsy has developed, treatment is directed toward the nerve disability rather than toward the cubitus valgus, exostosis or other deformity which may be present. The only treatment which has been found effective is surgical relocation of the ulnar nerve from the posterior aspect of the medial condyle to the antecubital fossa. After application of a pneumatic tourniquet, a curved longitudinal incision is made over the posteromedial aspect of the elbow, beginning about 2 inches above the medial epicondyle and proceeding distally in line with the course of the ulnar nerve for a distance of about 6 inches. The aponeurosis of the triceps tendon and the deep fascia are divided to expose the ulnar nerve over a distance of about 5 inches. The motor branches of the nerve, usually two in number, are isolated and, as the nerve is lifted out of its groove, these motor branches are carefully separated from the main trunk of the nerve to a point well above the elbow. This permits the surgeon to transfer the nerve anteriorly without placing undue tension upon these motor branches. In its new bed the nerve is carefully sutured in place between the deep and superficial fasciae, utilizing fascial loops in the region or sewing the two layers of fascia together to prevent backward displacement of the nerve. Bunnell[5] recommends that in muscular individuals it is probably better to re-route the nerve between the flexor profundus muscle and the flexor sublimus and pronator teres muscles by severing the epicondylar origins of the latter two muscles and reconnecting them after the nerve has been re-routed. This places the nerve in a muscular bed and minimizes the danger of further injury to the nerve from pressure upon it by outside objects.

If a psuedoneuroma is encountered in the ulnar nerve, a neurolysis is usually done. This is accomplished by making longitudinal incisions through the outer layers of the neuroma; these incisions are made at regular intervals by the use of a sharp razor blade. It is believed that such a neurolysis may hasten the regeneration of the paralyzed nerve.

Postoperatively the elbow is fixed at right angles using a snug but not con-

FIG. 1. Lateral and anteroposterior x-ray plates of right elbow showing extensive osteo-arthritis without evidence of old fracture.

stricting pressure bandage and a posterior molded plaster splint. After ten days the skin sutures may be removed and the arm placed in a sling. Rapid mobilization of the elbow joint may be encouraged, especially if the flexor sublimus and pronator teres muscles have not been detached.

The recovery of ulnar nerve function may extend over a period of twelve to fourteen months,[6] with nerve fibers growing at a rate of 3 mm. per day for the first one hundred days and 1 mm. per day thereafter.[7] Signs of nerve recovery follow a definite pattern: first, there is an arrest of further muscle atrophy or further sensory loss, then gradual disappearance of objective sensory loss and, finally, there is return of voluntary movement in the formerly paralyzed muscles.

COMMENT

A review was made of 154 cases with ulnar nerve lesions seen at the Cleveland Clinic from 1936 to 1948. In this group only nine cases were diagnosed as tardy ulnar palsy. We have obtained follow-up information in seven of these cases. The longest postoperative period is twelve years, the shortest, sixteen months. One patient considers himself entirely cured and six of the patients are improved.

FIG. 2. Case 1; severe cubitus valgus deformity of the left elbow.

Anterior transplantation of the ulnar nerve was carried out in seven cases. In one case this operation was advised but treatment was refused by the patient. In the other case, because of advanced age and poor general physical condition, conservative therapy was instituted. At the time of operation the ulnar nerve in the medial condylar groove exhibited a pseudoneuroma and fibrous adhesions in three cases, a pseudoneuroma alone in three cases and no demonstrable nerve lesion in one case. In each case the ulnar nerve was transplanted anteriorly between the superficial and deep fasciae. Neurolysis was carried out in four cases.

In seven cases there was a history of severe trauma to the elbow. Five cases had fractures of the lateral condyle, one had a fracture of both the lateral and medial condyles and one had a dislocation of the elbow without fracture, but with the subsequent development of severe osteoarthritis and multiple loose joint bodies. All of the fractures occurred in childhood. The period of time which elapsed between the original trauma and the onset of the ulnar

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FIG. 3. Case 1; preoperative atrophy of left hand musculature.
FIG. 4. Case 1; appearance of hand twelve years postoperatively showing complete regeneration of left hand musculature.

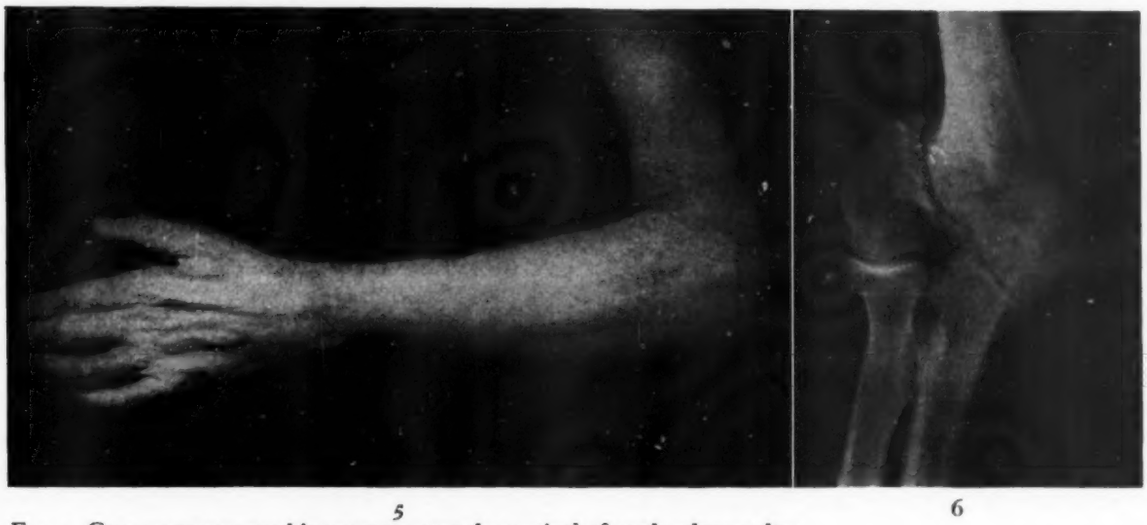

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FIG. 5. Case 11; pronounced interosseus atrophy typical of tardy ulnar palsy.
FIG. 6. Anteroposterior x-ray plate of left elbow showing an old ununited fracture of the left humerus with valgus deformity of the elbow and secondary hypertrophic change.

nerve symptoms ranged from fifteen to forty-seven years, averaging 32.5 years.

In two of the cases there was no history of previous trauma to the elbow and both had extensive osteoarthritis. One of these patients (Fig 1) was operated upon and no apparent abnormality of the ulnar nerve was observed. Anterior transplantation of the ulnar nerve was performed which resulted in definite improvement in the patient's symptoms. Three years following operation he reported that there was still slight numbness in the ulnar distribution of his hand but to a lesser degree.

The most frequent symptoms in all cases were weakness of the muscles supplied by the ulnar nerve and numbness in the ulnar distribution. Six of the cases revealed definite atrophy of the interossei and hypothenar muscles.

The average time which had elapsed between the onset of ulnar nerve symptoms and the first examination at the Clinic was fourteen months. This fact illustrates the insidious onset of tardy ulnar palsy.

CASE REPORT

The following cases demonstrate the typical clinical course of tardy ulnar palsy:

CASE I. A forty year old white man was first seen at the Cleveland Clinic in November, 1936. He complained of atrophy of the interosseus muscles of the left hand, with numbness and intense weakness in his hand of two years' duration. He had also experienced a burning sensation in the ring and little fingers for the past ten months, with increasing sensitivity to cold. He was unable to carry on his work as an electrician. The past history revealed a fracture of the left elbow joint at the age of two years. Examination of the elbow showed an increase of the carrying angle to 30 degrees. (Fig. 2.) There was severe interosseus and hypothenar atrophy, with hypesthesia over the ulnar nerve distribution in the left hand. (Fig. 3.) Roentgenograms showed an old healed fracture of the lateral humeral condyle with lateral and proximal displacement. On November 21, 1936, an anterior transplantation of the left ulnar nerve was performed. At the time of operation a pseudoneuroma with many fibrous adhesions was identified in the ulnar groove. Improvement began seven months after operation with reduction of numbness as the first sign in recovery of the ulnar palsy. One year postoperatively the sensation in the left hand was normal but the interosseus atrophy and weakness persisted for at least another year. At the present time, twelve years after the operation, he has no atrophy, weakness or numbness of the hand. (Fig. 4.) The patient considers himself completely cured and is able to carry on his usual occupation.

CASE II. A fifty-one year old white man noticed weakness and numbness in the distribution of the ulnar nerve in his left hand for a period of nine months. His past history revealed a fracture of the left elbow at the age of ten. Physical examination revealed moderately severe cubitus valgus deformity of the left elbow with the range of motion from 155 degrees extension to 45 degrees flexion. There was normal rotation in the forearm and slight crepitus at the elbow. The hand showed atrophy of the interosseus and hypothenar muscles, with sensory loss over the ulnar distribution. (Fig. 5.) X-ray examination of the left elbow revealed an old ununited fracture of the lateral condyle of the humerus with displacement proximally and laterally. (Fig. 6.) Anterior transplantation and neurolysis of the left ulnar nerve was performed on June 24, 1947. A large pseudoneuroma was found in the portion of the ulnar nerve lying within the paraolecranon groove. A follow-up examination sixteen months postoperatively revealed definite improvement of the sensory and motor function although there was still slight numbness in the ulnar distribution and moderate atrophy of the interosseus muscles.

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GERIATRIC ANESTHESIA

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THE spectacular increase in life span of the past forty years has created new problems not only in social and economic fields but in many phases of medicine and surgery as well. The purpose of this paper is to bring into sharper focus the fundamental nature of these problems as they affect the anesthesiologist as well as a present day approach to their anesthetic management.

The anesthesiologist is concerned directly with the senescent changes seen in the cardiovascular, respiratory and excretory systems. It is these changes which are mainly responsible for the diminished ability of the aged to maintain homeostasis in the face of strain. For example, the efficiency of the respiratory system is adversely affected by tissue fibrosis and loss of elastic tissue. Thus emphysema, usually of the atrophic variety, is common among these patients. This condition, combined with an increased susceptibility to depressant drugs, results in an increased tendency to hypostasis, atelectasis and many of the other respiratory derangements complicating surgical intervention. In the bronchi loss of elastic tissue and mucosal atrophy results in a retardation of bronchial functions. Consequently, the elimination of secretions and foreign matter from the respiratory tract is sluggish and inefficient. A late, overall effect of pulmonary aging is a state of chronic hypoxia due to diminished ventilation, a reduction in the number of functioning alveoli and decreased permeability of the alveolar walls.[1]

Only an incomplete listing of the important consequences of cardiovascular aging as they affect the anesthesiologist is possible here. These include: (1) increased incidence of cardiac irregularities and vascular spasms; (2) diminution of arterial elasticity and of blood supply to various organs, most significant in effect on function of heart, brain, kidney and liver; (3) hypertension; (4) decreased response or abnormal response to both vagal and sympathetic stimulation and (5) increased tendency to thrombosis and embolism associated with diminished plasma volume.

Certain pharmacologic deviations must also be kept in mind if a rational approach to the anesthetic treatment of the geriatric patient is to be attempted. The absorption of drugs, whether given by inhalation, rectum, mouth or subcutaneously, is generally slower than in younger individuals. Further, drugs which are eliminated via the respiratory tract or kidneys are lost more slowly. As one consequence of the reduced metabolic rate the destruction of drugs by oxidation or conjugation also proceeds more slowly. These factors naturally increase the possibility of toxic or of excessive cumulative action by drugs. Therefore, special caution must be exercised in the use of depressant drugs.

Many other changes accompany the aging process in various tissues and organs. While these may assume great importance in dealing with any individual patient, such detailed consideration is beyond the scope of this paper.

With these basic considerations in mind, the practical problem of the premedication for these patients may be discussed with better comprehension of the factors involved. Four basic reasons for premedication are to decrease the metabolic rate, allay anxiety, lessen secretions and diminish reflex activity.

Since age has already lowered the metabolic rate, psychic sedation remains as one of the major pre-anesthetic objectives. If the proper rapport is established between the patient and the anesthetist,

much can be accomplished toward mental preparation of the patient without recourse to drugs in dosages which may impair homeostatic mechanisms to a dangerous degree. This need for individual, sympathetic, consideration of every patient is so great that it is impossible to generalize about the dosage of drugs employed except to state that routine premedication, especially routine morphine dosage, must be shunned. The actual effects of morphine which provide the basis for this conclusion include its central depressant action on respiration, depression of the cough reflex, accentuation of bronchial spasm and a hypnotic effect which causes a general diminution of muscular tone.[2]

Atropine is commonly used for control of secretions and reflexes. Scopolamine, because of its central depressant effect which may cause an excited, uncooperative or stuporous patient, has been discarded for these patients by some anesthesiologists. Others continue to use this drug with good results, probably because of greater caution as to the dose they employ.

Atropine is frequently used with meperidine hydrochloride to produce a preanesthetic effect characterized by little or no respiratory depression, satisfactory sedation and excellent control of secretions.

Barbiturates in proper dose and time will result not only in an optimistic, well rested patient but frequently provide an excellent indication of the patient's susceptibility to sedative drugs. Barbiturates are also indicated when regional or local anesthetic procedures are contemplated. A small dose of one of the shorter acting barbiturates given two hours before the induction of anesthesia will enhance the sedative action of the opiate and exert a protective action against the toxic effects of the local anesthetic agent.[3] It should be remembered, however, that barbiturates like scopolamine may cause excitement and confusion.

Insufficient premedication frequently can be made adequate by an understanding, reassuring attitude on the part of the anesthetist. If necessary, additional intravenous medication may be employed in judicious dosage. Oversedation, on the other hand, will make the induction of anesthesia more hazardous even in the hands of the most skillful and may necessitate the postponement of the procedure.

Mention should be made of some of the preoperative therapeutic medications which may affect the course of anesthesia beneficially. These include blood and other fluids, vitamins, anticoagulants, antibiotics and hormones.

Although partial plates and small removable dentures should be removed as part of the pre-anesthetic preparation, intentionally allowing elderly patients to retain their full plates will result in an improved psychic outlook by certain patients and will frequently simplify the induction and maintenance of inhalation anesthesia.

ANESTHETIC METHODS AND AGENTS

The selection of an anesthetic method should be based on an evaluation of the patient and his condition, especially his cardiovascular, pulmonary and renal status, the methods available, the anesthetist's abilities and the surgeon's needs.

Local and Regional. With this type of anesthesia many of the systemic effects of general anesthesia may be eliminated. Coincident with the improvement in administration of general anesthesia has come the realization that, for many individuals, local procedures may be more shocking than general anesthesia. On the other hand, certain operative procedures lend themselves extremely well to skillfully induced local anesthesia. Abdominal field blocks for enterostomy, colostomy and cystotomy, as well as the various extremity blocks for orthopedic procedures, are examples. Caudal block for rectal and perineal procedures has proven extremely useful. Peridural block anesthesia has been more popular in South American and European clinics than in this country, possibly because of the technics involved.

The demonstration by Curbello in Cuba of the feasibility and wide applicability of continuous segmental epidural block may lead to more extensive employment of this method in this country both for surgery and as a therapeutic measure.[4]

The axiom that as far as the patient is concerned no really good anesthesia can be purely local applies with equal or greater force to the geriatric patient. Supplementation with large amounts of sympathetic attention and minute quantities of sodium pentothal and oxygen can convert an ordeal into a comparatively pleasant experience.

Spinal Anesthesia. For many procedures which can be performed with anesthesia levels below D10 spinal anesthesia may be the one of choice. The tendency today is toward the use of smaller quantities of the anesthetic agents, especially in elderly patients. With skill and care surprisingly small doses are found to be entirely adequate. Unilateral anesthesia, permitting further reduction in dosage and systemic effect, is frequently possible. Of course, the absolute and relative contraindications such as central nervous system disease, severe anemia, severe hypertension, shock, marked blood pressure fall following premedication and an uncooperative attitude by the patient must be considered in each case. Supportive therapy includes ephedrine at the time of the spinal tap, intravenous fluids and oxygen, both started immediately following induction. The use of continuous spinal anesthesia for lengthy operations adds to the safety of the method.

Refrigeration Anesthesia. For elderly, debilitated patients who are to undergo amputation of an extremity, refrigeration has been reported to be a method of choice. Many patients actually seem to improve after the induction of anesthesia. The disadvantages are the slow and cumbersome nature of the method.

Intravenous Anesthesia. Sodium pentothal in a 0.1 or 0.2 per cent solution is a suggested drug for many minor procedures such as manipulations and examinations. The smooth, pleasant, induction and the absence of frightening apparatus are important advantages. When given as a supplement to regional and local anesthesia, it is of especial value in deaf and dumb, senile and other apprehensive patients whose cooperation may be difficult to obtain.[5] In conjunction with curare and a 50:50 mixture of nitrous oxide and oxygen the method lends itself to almost any procedure. Because of the generally diminished autonomic reactivity of the aged, contraindications are fewer than with young, vigorous patients.

Basal Anesthesia. Basal anesthesia is extremely satisfactory from the psychic standpoint. Ether in oil, avertin and sodium pentothal have been employed rectally to produce basal anesthesia. As with other drugs, variability and toxicity tend to be greater in the aged. Generally speaking, therefore, dosage should be much reduced. The unfortunate experiences of the past in connection with basal anesthesia have almost always resulted from overdosage, either inadvertently due to lack of familiarity with the method, or deliberately, in an attempt to produce surgical anesthesia by this means alone.

Romig and Donahue have reported on their successful use of avertin for basal anesthesia in the aged.[6] Rectal sodium pentothal also has been employed with success for basal analgesia, but the variability of action appears to be greater than with avertin and the duration of action appreciably shorter. Gwathmey was one of the original exponents of rectal ether oil anesthesia.[7] However, the same factors which tend to make inhalation ether disadvantageous in the aged have made this method less popular than basal avertin. Similarly, basal anesthesia with intravenous ether has been employed without any real advantages and some serious disadvantages making themselves apparent.

Inhalation Anesthesia. At the present time inhalation anesthesia remains the mainstay in the clinical anesthetist's approach to anesthetic choice. The different

agents available should be evaluated from the standpoint of the altered physiology of the aged patient. Nitrous oxide, for example, because of its low potency which frequently tempts the administrator to employ it with diminished oxygen tensions, is usually contraindicated as a sole agent. The potency of ethylene, on the other hand, while considerably less than that of cyclopropane, is sufficient to permit many procedures to be performed with adequate oxygenation and relaxation. Requirements in these patients for a potent agent are so much less that ethylene naturally makes an ideal agent for them. Because of its potency cyclopropane permits high oxygen concentrations and has wide applicability. Due to its comparative pleasantness for induction and its favorable effect on hemodynamics as compared with ether or pentothal,[8] it has few contraindications in the hands of those experienced with it. By adding small quantities of ether to the mixture the stability and safety of the anesthesia may be increased, and by giving procaine in an intravenous infusion during the operative procedure it has been successfully employed even when relative cardiac contraindications existed.[9]

Ether finds its major use in geriatric anesthesia as a supplementing agent, using small amounts only, rather than as a primary anesthetic agent. Its unfavorable effect on hemodynamics has been mentioned.

Curare. The role of curare in increasing the safety of anesthesia by providing adequate relaxation for the surgeon while the patient is in light anesthesia has been firmly established. Its dangers and the fact that its use will not compensate for poorly given anesthesia have been equally well established. Clinical and experimental work now in progress seems to indicate that in addition to its effect on the myoneural junction, curare in large doses has a beneficial effect on certain types of reflex activity. Thus, obtundation of certain reflexes quite similar to that seen under deep general anesthesia may be possible without any general anesthesia at all. This may explain the observation that very light anesthesia, such as that produced with nitrous oxide and "heavy" curarization, is, contrary to expectation, accompanied by decreased shock.

Supportive Therapy. Because of their comparatively diminished ability to compensate for blood loss, positional disadvantages and operative trauma, supportive therapy during anesthesia must be anticipatory whenever possible. There is no good rationale for the postoperative transfusion. Blood loss should be compensated for almost "before" it occurs. If clinical evidence of excessive blood loss is awaited, irreversible shock may set in.

Plasma and saline constitute poor substitutes for blood. The same is true for the analeptics, and their use in a patient whose compensatory mechanisms are already strained to the utmost may be followed by total collapse.

The special supportive measures—ephedrine, oxygen and fluids—required under spinal anesthesia have been previously mentioned. Here, too, the aim is the *prevention* of drastic changes in the status of the patient. Such changes, if allowed to occur, may do irreversible damage to the brain, heart and kidneys.

No matter what type of anesthesia is employed, the diminished vital capacity of the elderly patient demands that special attention be paid to positioning both during and after operation. The Trendelenburg, lithotomy and kidney positions are the most detrimental for the patient in this respect.

Post-anesthetic Care. An important aim of postoperative care is the prevention of circulatory and respiratory complications. The role of the anticoagulants, of paravertebral sympathetic block and of prophylactic venous ligation has been adequately discussed by others.[10,11] An intelligently carried out regimen involving frequent moving about and early ambulation of the patient will greatly diminish the incidence of vascular accidents. Such a regimen, in

combination with scrupulous attention to the hygiene of the respiratory tract, will do much to prevent respiratory complications during the postoperative period.

Too early or excessive postoperative sedation is hazardous. About 30 per cent of patients require no analgesic administration in the postoperative period. Intercostal blocks following abdominal surgery, making use of intracaine in oil or similar preparations, are valuable for increasing the comfort of the patient and decreasing the need for sedation.[12] Demerol and codeine are frequently entirely adequate analgesics. When morphine is necessary for control of pain, it may be given with prostigmin to avoid the adverse effects of morphine given alone on the gastrointestinal tract.

Oxygen therapy is frequently indicated for these patients but any tendency to an indiscriminate or routine use should be avoided. Similarly, postoperative blood and fluid therapy should be administered on the basis of laboratory determinations as well as clinical impression.

Conscientious, sympathetic nursing care exerts a beneficial effect, not only by carrying out the prophylactic maneuvers already alluded to but by actually permitting a reduction of depressant medication to the necessary minimum. The value of a well run recovery ward in facilitating this type of care cannot be overestimated.

SUMMARY AND CONCLUSION

Some of the factors involved in the selection and administration of anesthesia to the geriatric patient have been discussed. The need for individualization has been emphasized. Some aspects of pre- and postoperative care have been considered.

The principles of good anesthesia remain the same whether the patient is young or old. While cautious, exacting application of these established principles constitutes the essence of good anesthesia, good geriatric anesthesia requires even greater devotion to minute details.

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INTRADIPLOIC EPIDERMOID TUMORS (CHOLESTEATOMA OF THE SKULL)*

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EPIDERMOIDS, cholesteatomas, pearly tumors, or Cruveilhier's[1] tumeurs perlées are rare neoplasms of ectodermal origin. Remak[2] in 1854 advanced the thesis that these tumors are embryonic rests resulting from an incomplete separation of the neural from the surface ectoderm. They may occur within the skull or may arise within the diploe, causing erosion of the tables of the skull and pressure upon the underlying brain. They may arise within the ear and break through into the intracranial cavity, or may arise in or upon the brain itself.

Although true epidermoids may occur in connection with the internal ear, most of the masses referred to as cholesteatomas are in reality infectious débris consisting of ingrowing squamous epithelium, secondary to chronic infections in the ear and not true neoplasms. Epidermoids have been loosely called cholesteatomas and much discussion has arisen as to the propriety in the use of the term "cholesteatoma," since it is descriptive only of the chemical by-product of the tumor, cholesterin, not invariably present. Many years ago epidermoids were distinguished from dermoids on the basis of their embryology. This belief was supported by evidence that dermoids were the result of misplaced ectodermal cells, occurring from the third to the fifth week of fetal life; while epidermoids represent disturbances to the anlage after the neural groove has been closed, occurring after the fifth fetal week and resulting in the growths found in the meninges, diploe and superficial layers of the calvaria.

According to Pancoast[3] et al., true intradiploic epidermoids are very rare but occasionally give rise to neurologic symptoms. Since 1922, when Cushing[4] reported a case of his own, some forty-one cases have been recorded in the literature and the surgical treatment of this condition has been placed on a firm basis. The clinical and x-ray picture which is caused by this tumor is typical and scarcely to be confused with any other condition. The examination usually presents a swelling on the surface of the skull which may have been present for some years. Ordinarily there is an associated palpable defect in the normal contour of the skull; such defects are generally surrounded by a bony ridge as the edges of the lesion are frequently surrounded by a mass which is soft and fluctuant. If the inner table of the skull has been eroded, transmitted pulsation of the tumor mass may be elicited. X-ray examination reveals a defect in the bones of the skull which may or may not be regular. The margins of the defect may be scalloped or smooth. The defect itself is caused by a tumor which arises within the diploe, spreading and eroding the inner and outer tables of the skull. At operation an encapsulated cyst is found presenting a whitish caseous mass or a series of whitish rings having the appearance of mother-of-pearl. The capsule is extremely thin and friable and is separated from its bony crater with difficulty. Since the wall of the cyst is composed of stratified squamous epithelium this must be completely removed in order to prevent recurrence; mere evacuation of the cyst is not sufficient.

Mahoney[5] in 1936 discovered only twenty-three diploic epidermoids in a

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series of 142 cases that he could find in the literature to which he added five cases collected in Foerster's Clinic, in Breslau. Mueller[6] in 1936 was the first to describe an intradiploic epidermoid and, aside from the three cases described by Bucy,[7] two by Rowbotham,[8] four by King[9] and ten recently described by Rand and Reeves,[10] only forty-one cases of epidermoids arising between the two tables of the skull have been culled from the literature to date.

This report is concerned with two cases of epidermoids of the calvarium in one of which there has been a highly suggestive history of preceding head injury.

CASE REPORTS

CASE 1. This patient had a swelling in the right frontal region since the age of seven years following a head injury. There was a slow increase in size until the age of fourteen years associated with constant headaches and unsightly cosmetic deformity of the forehead. Operation consisted of removal of epidermoid of skull followed by immediate recovery. There was a recurrence three years later. Re-operation was carried out with removal including the pericranium and complete recovery followed.

S. N., a fourteen year old Junior High School student, referred by Dr. M. H. Rabwin, was admitted to the Queen of Angels Hospital, Los Angeles, July 12, 1944, because of swelling in the right side of the forehead. When she was seven years old, she bumped heads with another child, receiving a laceration in the right frontal region. She said she remembered this and that she was taken to the Receiving Hospital where six stitches were used to close the cut in her forehead. About six months later a bump began to form at the site of the scar. This continued and gradually became larger until it finally reached the size of a walnut. There had been moderate headaches present during the past seven years. However, the swelling in the right frontal region did not become painful.

Examination revealed a perfectly normal appearing girl in good general physical condition. In the right frontal region about midway between the eyebrow and the hair line was a swelling which was quite symmetrical and measured approximately 3 by 3 cm. in diameter. It was elevated about 1.5 cm. above the surrounding scalp. A fine linear scar ran transversely across this elevation. From the dome of this elevation one received the impression of an indentation, with a sense of fluctuation. The edges were quite firm and crater-like. There were no signs of inflammation and no definite localized tenderness. There were no neurologic signs noted. The deep reflexes were quite sluggish but about equal. There were no abnormal reflexes. X-rays of the skull (Figs. 1, 2 and 3) showed a perfectly circumscribed bony defect in the right frontal region and outside of the right frontal sinus. It measured approximately 2 by 3 cm. in diameter. The margins were clear cut and appeared to have been caused by a pathologic process of a benign nature. In a tangential view the outer surface of the structure was elevated above the normal surrounding bone.

FIG. 1. Case 1; roentgenogram of skull, anteroposterior view showing circumscribed bony defect in the right frontal region characteristic of epidermoid tumor.

At operation on July 22, 1944, a semi-circular incision was made in the right frontal region behind the hair line, and upon reflecting the scalp flap downward a soft tumor mass was uncovered in the right frontal area and above the eyebrow, which appeared to be well encapsulated and was entirely beneath the peri-

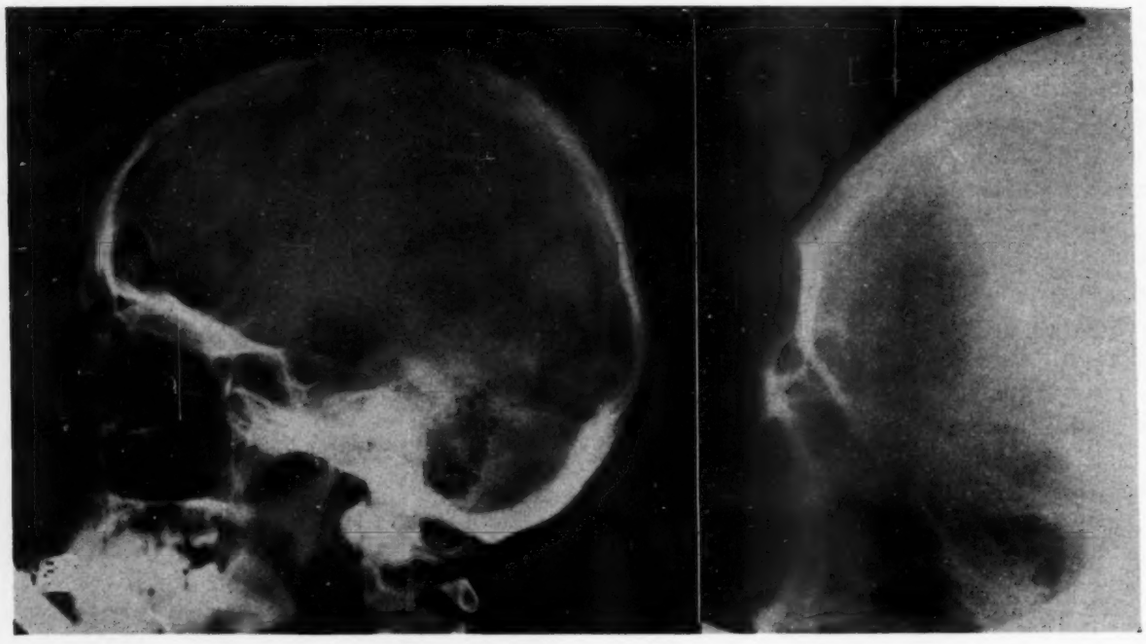

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FIG. 2. Case 1; roentgenogram, lateral view, showing clear-cut, smooth margins of epidermoid tumor.
FIG. 3. Case 1; roentgenogram, tangential view, indicating the outer surface of the epidermoid to be elevated above the normal surrounding bone.

cranium. The tumor mass had its bed between both tables of the skull bone. The capsule of this tumor mass was carefully reflected away from the bony walls of the frontal bone and the entire contents were removed *in toto*. The size of this tumor mass was that of a walnut and its consistency was that of brick cheese. The bony bed of the neoplasm was inspected and found to be composed of an inner table of the skull, which was intact, the diploe and the eroded outer table. The cyst lining of this bony bed was carefully removed with a curette; the edges of the outer table were smoothed down with a chisel and the opening through the outer table was closed by suturing together the pericranium. The scalp flap was then returned to its normal position and the wound was closed in layers with interrupted black silk. The patient made a complete recovery and was discharged from the hospital at the end of two weeks.

Microscopic examination of the specimen revealed abundant non-descript keratin-like material arranged in layers. The color of this material was of a shiny, glistening white. Also seen was a thin fibrous transparent membrane representing a cyst wall. Microscopic examination (Fig. 4) of the cyst wall revealed on the lining aspect a thin layer of well formed stratified squamous epithelium, the basement membrane of which was intact. Beneath this epithelial layer was a dense, fibrous connecting tissue. There were no glandular elements. The gross appearance of the contents of the cyst, together with the absence of glandular elements in the cyst wall, indicated that the cyst contained the accumulation of years of desquamated epithelium.

Comment. In this case there was the unusual history of a head injury which occurred seven years before the patient's admission to the hospital. The tumor was located directly beneath the site of the injury in the right frontal region and was associated with the typical defect in the skull. It was thought that perhaps some epithelial cells were driven down into the bony tissues at the time of this accident, thus giving rise to an epidermoid tumor. This patient returned to her classes in school and apparently did very well for several years. During the summer of 1947 she again noticed some swelling beneath the operative site in the right frontal region which felt soft and movable and evidently was a slow-growing recurrence of the original tumor mass. X-ray examina-

tions of the skull were made which again showed a circumscribed bony defect in the right frontal region entirely similar to the pictures made some three years previously. Physical examination at this time revealed no neurologic signs. The swelling in the right forehead felt fluctuant with firm edges and was elevated approximately 1 cm. above the surrounding scalp. The diagnosis of a recurrent epidermoid tumor of the skull was made.

On February 25, 1948, utilizing the original incision behind the hair line in the right frontal region, the scalp flap was turned down, uncovering the recurrent epidermoid tumor approximately the size of a small walnut in the right frontal bone. The pericranium about the tumor mass was incised and the underlying tumor was removed from its bed in the cranial vault. The outer table of the skull was found to be eroded and the base of the tumor was resting in the diploe. The bony bed was carefully curetted so that no fragments of the cyst wall were left behind. In closing this wound the evident mistake made some four years ago was not repeated when the pericranium had been closed over the bony defect in the skull. At this session the pericranium and the tumor mass were removed together precluding any further growth. The scalp flap was returned to its correct position and closed with multiple black silk sutures. The patient made an uneventful recovery and was discharged from the hospital five days later. To date there has been no sign of any further trouble.

Case II. This patient complained of swelling in the right parietal region during the past seven years associated with severe headaches. There was an increase in size of the tumor mass to that of an orange. Frequent nausea occurred during the past year. The bony defect showed crater formation. The operation consisted of removal of the epidermoid tumor and the patient recovered.

N. S., a twenty-seven year old seamstress, referred by Dr. Walter Holleran, was admitted to the Queen of Angles Hospital on January 29, 1947, because of headaches and swelling of the scalp in the right parietal region. About seven years previously the patient had noticed a protuberance in the right side of the head about the size of an olive, which grew slowly until it reached its present size of a small orange. At first it was very hard but later became soft and doughy. The patient never attached any importance to the tumor and thought that the headaches were due to some ailment of her eyes, so she went to an optometrist to have glasses fitted which did not relieve the condition. About one month before her admission to the hospital the patient had frequent periods of nausea and lost her appetite completely. There were no other complaints. She had the usual diseases of childhood. At the age of fifteen years she had two convulsive seizures which did not recur. She had an attack of malaria eight years previous to her hospital admission. There was no history of any accident or head injuries.

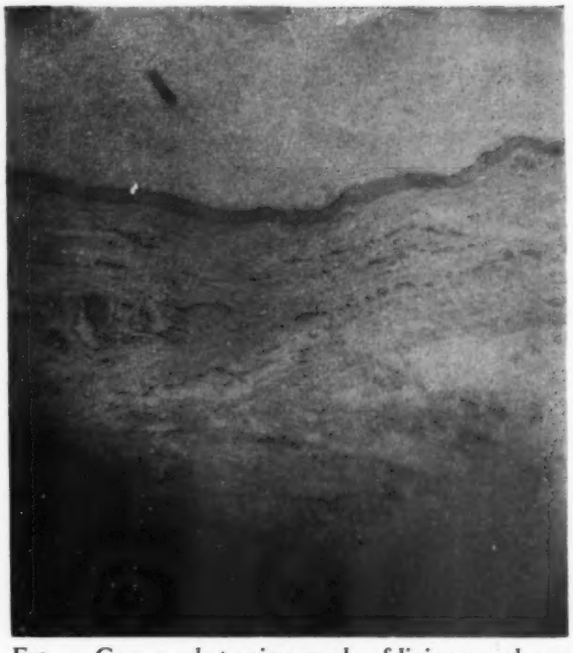

Fig. 4. Case 1; photomicrograph of lining membrane of epidermoid tumor showing layer of stratified squamous epithelium on which the growth of the tumor depends.

Examination revealed a pale appearing, twenty-seven year old girl in good general physical condition. In the right parietal region was a swelling the size of a tangerine which was quite fluctuant and soft and which measured approximately 5 cm. in its greatest diameter. There were no signs of inflammation and no definite localized tenderness. There were no objective neurologic signs noted.

X-ray examination (Figs. 5 and 6) revealed a sharply circumscribed defect in the right parietal bone. There was marked condensation of the margins of this defect. Overlying it was a shadow of the tumor mass. Tangential views

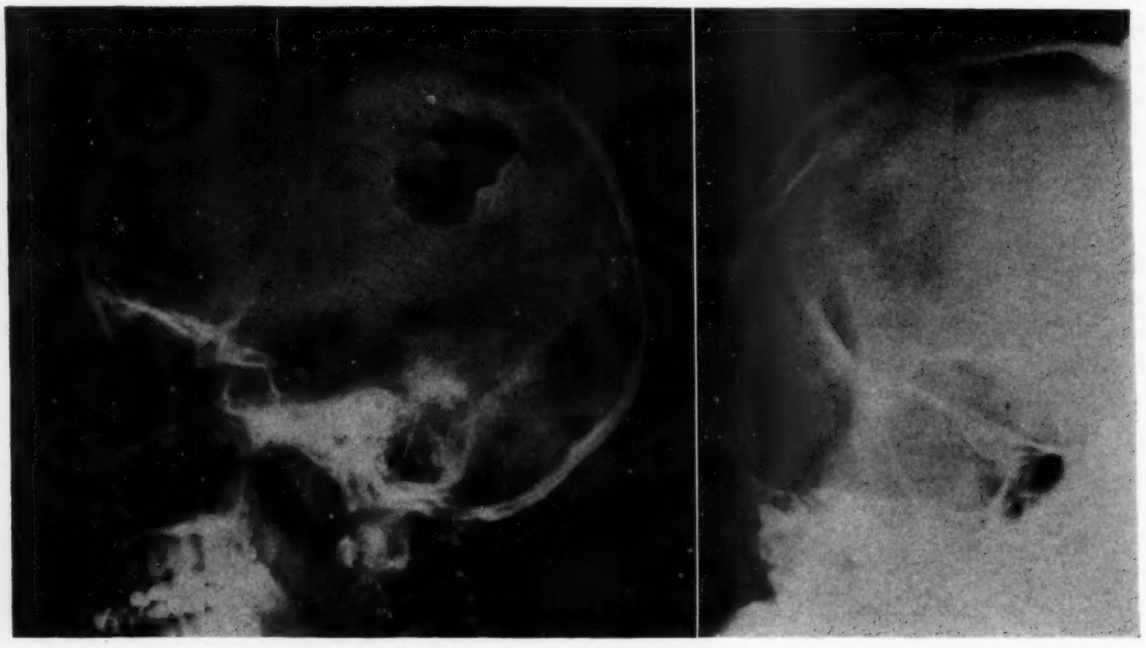

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FIG. 5. Case 11; roentgenogram, lateral view, showing cholesteatoma, epidermoid of the cranial vault, with circumscribed defect in the right parietal bone. Overlying this defect is shadow of tumor mass.
FIG. 6. Case 11; roentgenogram, tangential view, showing destruction of the outer table of the parietal bone and depression and erosion of the inner table.

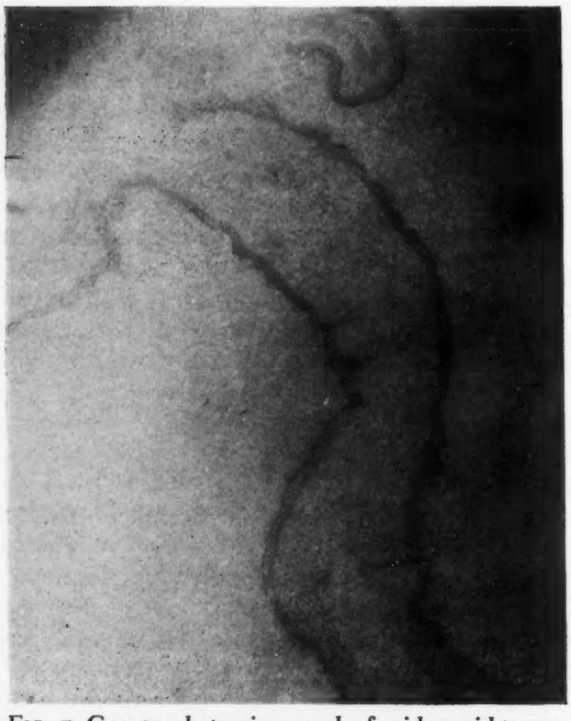

FIG. 7. Case 11; photomicrograph of epidermoid tumor with intact basement membrane of stratified squamous epithelium. There is a large amount of desquamated epithelium present which accumulated over a number of years.

demonstrated the destruction of the outer table of the parietal bone and depression of the inner table by expansion. The findings were consistent with a new growth involving the parietal bone and probably represented a cholesteatoma.

On January 21, 1947, a semi-circular flap of the scalp in the right parietal area was made, encircling the tumor mass for a distance of approximately two-thirds around its circumference. Upon reflection of this scalp flap a soft tumor mass was uncovered which seemed to have its origin in the ballooned-out diploe of the right parietal bone. An attempt was made carefully to dissect out and encircle this tumor mass without injuring it. However, at one point the capsule was so thin and friable that it broke open, allowing much of the cheesy, yellowish-white contents to escape. This was followed by a meticulous dissection of the entire capsule which seemed to fill a crater within the right parietal bone, easily 4 by 4 cm. in its greatest diameter. At the base of the crater an area of erosion down to the dura was discovered, exposing this membrane for at least 1½ cm. The bony defect was carefully curetted to remove every piece of capsule lining and therefore prevent any recurrence. The scalp flap was then closed with multiple interrupted black silk

sutures and the patient was returned to bed in good condition.

She made an uneventful recovery and was discharged from the hospital at the end of ten days.

The tumor specimen consisted of a collapsed cystic mass approximately 4 cm. in diameter. The wall was thin and fibrous. The lining surface was smooth and was covered with some adherent glandular gray sebaceous material representing the contents of the cyst.

Microscopic examination (Fig. 7) of the cyst wall showed on the lining surface a thin layer of essentially normal, stratified squamous epithelium the basement membrane of which was intact. The rest of the cyst wall was made up of a dense fibrous, partly hyalinized connective tissue. No dermal glands or hair follicles were seen in the section. On the outer aspect there was some fatty tissue and a small amount of striated muscle.

Diagnosis: epidermoid cyst.

Comment. This case represented a typical history of a tumor of long duration, with a clear cut defect of the skull recognized in the x-ray studies. Of interest, also, was the erosive action of the tumor causing a defect in the inner table of the skull exposing the dura. It is this type of case which might easily give rise to convulsive seizures, particularly when located in the parietal region, and which calls for diligent search of the bony crater and the surface of the exposed dura for any bits of lining which could give rise to recurrence.

SUMMARY

1. Two epidermoid tumors arising in the diploe of the frontal and parietal bones of the skull are described.

2. In Case 1 the tumor appeared to follow closely a head injury, an etiologic factor which heretofore has never been given serious consideration.

3. In both cases the patients complained of constant headaches and there was marked cosmetic deformity.

4. The roentgenographic findings in these lesions are extremely characteristic and may be recognized preoperatively in the majority of instances.

5. The term "cholesteatoma" is confusing and should be avoided. The classification, primary cranial and intracranial epidermoids, as suggested by Monroe and Wegner,[11] indicates the true type, origin and location of these tumors.

6. Although these tumors are benign, the covering membrane of epithelium is active, and in order to prevent recurrence this lining membrane must be entirely removed at operation. One patient reported by Rand and Reeves[10] underwent operation four times before final removal and recovery took place.

7. Whenever the inner table of the skull has been found to be eroded, a careful search for an intracranial extension should be made.

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SURVEY OF COMMON DUCT STONES IN CLINICAL AND NECROPSY CASES*

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THIS study is based upon all cases of common duct stone admitted to the hospital for a period of twelve years, together with a review of all such cases found at postmortem examination at which time no such clinical diagnosis was made.

This review emphasizes the ease of recognition and the serious implications of common duct stones. It brings into relief the severe complications and mortality associated with conservative therapy. It emphasizes the necessity of exploring the common duct more frequently when removing a gallbladder, if the gallbladder is thick and contracted or if it contains black and tenacious bile; if there is jaundice; if the common duct is dilated and obviously if a stone can be palpated within. It shows the frequent need of aspirating the common duct in the absence of other indications, and then of exploring it if the bile is cloudy or contains flocculi because of the frequent presence of stones or chronic infection in the presence of such bile. It shows the real improvement following common duct drainage although no stone may be present.

The indications for exploring and draining the common duct, as emphasized by various authorities,[1–8] may be summarized as follows: (1) jaundice; (2) pain; (3) palpable stones in common or hepatic ducts; (4) dilated or thickened common duct; (5) chills and fever; (6) thickening of head of pancreas; (7) contracted gallbladder; (8) multiple small calculi or sand in gallbladder when cystic duct is large; (9) recurrent symptoms after cholecystectomy; (10) calculi removed from stool; (11) sediment in aspirated common duct bile.

In our series there were fifty-nine cases of common duct stones admitted to the hospital with this as a primary diagnosis, or patients who developed this complication while hospitalized. They show the frequency of pain, indigestion, acholic stools, jaundice, dark urine, chills and fever. The number of cases that presented signs and symptoms of common duct stones shortly after cholecystectomy is noteworthy.

In this survey the youngest patient was twenty-nine years old, the oldest sixty-nine. The chart shows the distribution of the cases by decades. There were forty-five females (74 per cent) and fourteen males (26 per cent).

Jaundice was the most common symptom appearing in forty-five (76 per cent) cases. Right upper quadrant pain was next, occurring in thirty-seven (63 per cent) cases. The associated symptoms in order of descending frequency were: (1) pain radiating to right scapular region or shoulder (twenty cases); (2) epigastric pain (nineteen cases); (3) vomiting (seventeen cases); (4) very dark urine (sixteen cases); (5) acholic stools (fourteen cases); (6) nausea (fourteen cases); (7) belching, bloated feeling (twelve cases); (8) pruritus (ten cases); (9) fever (eight cases); (10) chills (five cases). The associated physical findings in order of descending frequency were: (1) right upper quadrant tenderness (twenty-one cases); (2) enlarged liver fourteen cases); (3) fever (eight cases).

The common laboratory findings were: (1) icteric index above normal (twenty-seven cases); (2) cholesterol above normal (nineteen cases); (3) cholesterol ester ratio less than 40 per cent (ten cases). Since

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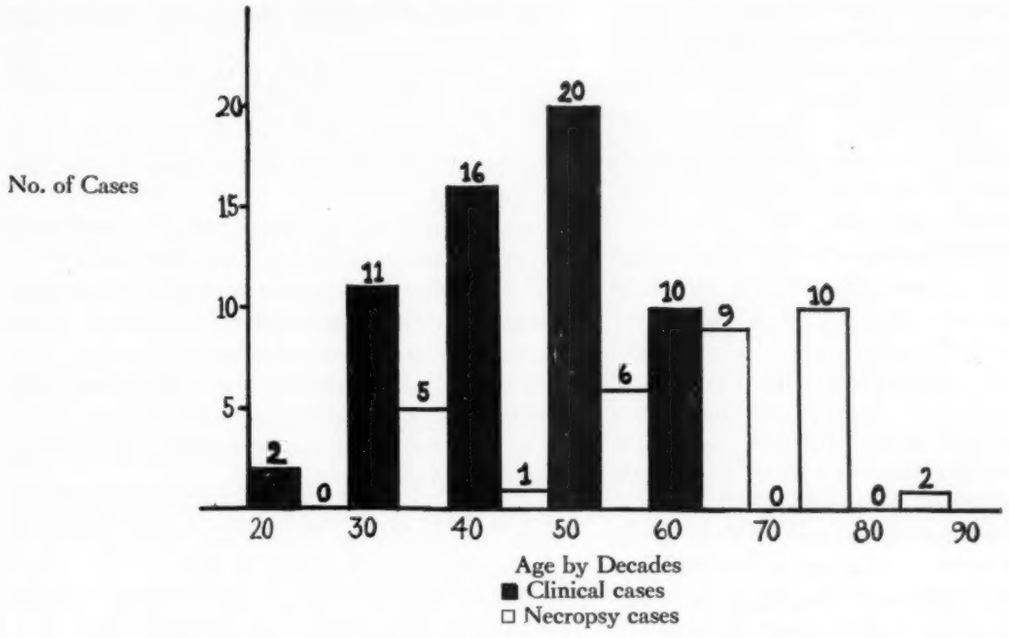
many of these cases go back several years, the laboratory data of other liver function tests such as Van den Bergh reaction and cephalin flocculation tests were insufficient to include them in this report.

It is interesting to note that seventeen (29 per cent) of the aforementioned patients had had a previous cholecystectomy and of these four had been operated within a period of two to three months prior to this admission. Six patients had had a previous cholecystostomy, making a total of twenty-three patients (39 per cent) requiring reoperation.

Twenty-five of the fifty-nine patients underwent a common duct exploration. Common duct stone was found in all but two. All patients responded well to the removal of the stones and T-tube drainage of the common duct except one in whom the technical difficulties of exposing the common duct were insurmountable and the patient succumbed shortly postoperatively. Postmortem examination showed a common duct stone with ascending cholangitis.

Twenty-two patients were not operated upon and according to the record the condition subsided spontaneously. This group is included because the history and physical findings were suggestive of common duct stones. There is no operative proof that the diagnosis was correct.

Twelve patients were so diagnosed on admission or while hospitalized but signed out against advice before operative intervention or spontaneous subsidence.



A review of the material from the Department of Pathology brought to light thirty-three cases of common duct stones. Of these fifteen had been operated upon and eighteen had not. The distribution of the cases according to age is shown on Figure 1. There were thirty-two white and one colored patient. Of these eleven were male and twenty-two female. Fifteen of these patients gave a history of abdominal pain; fourteen a history of jaundice; fourteen a history of chills and fever. Six had no biliary symptoms or signs.

The following is a list of the causes of death of the patients not operated upon in most of whom the common duct stones were incidental findings at the postmortem table:

1. Stones in the common duct associated with chronic cholecystitis in a case of bronchopneumonia
2. Stones in the common duct associated with chronic cholecystitis and cholelithiasis

in a case of osteogenic sarcoma of humerus with metastases

3. Common duct stones and chronic cholecystitis in a case of sickle cell anemia with subarachnoid hemorrhage

4. Chronic cholecystitis, cholelithiasis, choledocholithiasis with dilatation, chronic cholangiolitis in a case of adenocarcinoma of rectum and congestive heart failure

5. Chronic cholecystitis and choledocholithiasis in a case of coronary thrombosis with extensive myocardial infarction

6. Chronic cholecystitis, cholelithiasis and choledocholithiasis in a case of toxic hepatitis

7. Choledocholithiasis in a case of carcinoma of the head of the pancreas

8. Choledocholithiasis in a case of cholangitis due to stones in the biliary tree with recent coronary occlusion

9. Chronic cholecystitis, cholelithiasis, impacted stone in cystic duct with hydrops of gallbladder; impacted stone in common duct in a case of old and recent coronary occlusion

10. Choledocholithiasis in a case of ruptured gallbladder with regional abscess

11. Chronic cholecystitis and cholelithiasis; calculus in the common duct in a case of lobar pneumonia and cirrhosis of the liver

12. Stones in the common duct in a case of acute pancreatitis

13. Stone in the common bile duct in a case of cholangitis with severe biliary cirrhosis

14. Common duct obstruction by calculus in a case of cholemia

15. Chronic cholecystitis, cholelithiasis, choledocholithiasis in a case of acute endocarditis with multiple embolization

16. Cholemia due to obstruction by stone in the common duct in a case of papillary carcinoma of the gallbladder

17. Cholemia due to stone in common duct in a case of incarcerated ventral and inguinal hernia

18. Subphrenic abscess, cholecystitis, cholelithiasis, choledocholithiasis in a case of coronary sclerosis and nephrosclerosis

The following is a list of causes of death in the patients operated upon:

1. Massive and extensive subphrenic abscess following drainage of common hepatic duct and appendectomy

2. Postoperative biliary fistula (common bile duct); obstructive jaundice; intra- and extrahepatic calculi

3. Massive intraperitoneal hemorrhage following cholecystectomy

4. Generalized peritonitis following cholecystectomy

5. Duodenal fistula with regional abscess following choledochostomy for impacted calculus

6. Coronary thrombosis with extensive myocardial infarction following cholecystojejunostomy

7. Acute pancreatitis with coronary insufficiency after cholecystectomy

8. Carcinoma of head of pancreas with widespread metastases; status post-cholecystojejunostomy

9. Generalized peritonitis with perforated diverticulum; post-cholecystduodenostomy

10. Localized peritonitis with subphrenic abscess and hemoperitoneum following cholecystostomy and choledochostomy

11. Subdiaphragmatic and abdominal wall abscess with choledochoduodenal fistula

12. Common duct obstruction by stone, post-cholecystostomy

13. Sepsis in a patient with erysipelas of breast on whom a cholecystectomy was performed; calculus in common duct

14. Myocardial insufficiency and portal thrombosis; status after cholecystostomy

15. Abscess of gallbladder with extension to liver; peritonitis; status after cholecystostomy

Six of the above fifteen patients had only cholecystectomies or cholecystostomies performed although the postmortem examination showed common duct stones. Jaundice associated with pain and chills and fever are the common symptoms differentiating common duct stone from other conditions, such as carcinoma of head of the pancreas. An analysis of the thirty-three postmortem cases shows the following causal relationship of common duct stones to death:

		Unoperated No. Cases	Operated No. Cases
Symptomatic	Non-contributory	None	9
	Contributory	12	5
Asymptomatic	Non-contributory	6	0
	Contributory	None	0

In the patients not operated upon common duct stones were the causative factor of death in twelve who had symptoms referable to the gallbladder; in no case in this group did it not bear relationship to death. In the six patients not operated upon who had no gallbladder symptoms there was no causal relationship between the common duct stones and death. Obviously all of the fourteen patients operated upon had gallbladder or common duct symptoms. Of this group, common duct stones were the contributing factor in five and non-contributory in nine patients who died.

A follow-up survey of the clinical cases yielded the following information: We tried to contact all but succeeded in reaching only four of the male patients and eleven of the female patients. Of the male patients two had had a cholecystectomy and choledochostomy and they reported no symptoms since operation. One of the two reported occasional heartburn and eructations after fried foods. One patient with a clinical diagnosis of common duct stones but who refused operation and signed out against advice reported no symptoms since discharge from the hospital. The fourth patient died six years after his discharge from the hospital and the cause of death was cerebral hemorrhage. He had developed jaundice with pain eight months after cholecystectomy. The jaundice had subsided spontaneously and he was not operated upon. He had no gallbladder symptoms since his discharge from the hospital.

Of the eleven female patients seven had had a cholecystectomy and choledochostomy. Two had reported no symptoms since operation. Two had refused operation and had signed out against advice. On these two cases the diagnosis of common duct stone had never been proven. They reported no symptoms since discharge. One patient had had a cholecystectomy elsewhere in 1917. Her diagnosis at this hospital in 1937 was that of common duct stone. She refused operation and left the hospital against advice. She died in 1945 of cerebral hemorrhage. Another patient with a similar diagnosis, who also refused operation, died three years later of a cerebral hemorrhage. Neither one of these patients had any symptoms referable to the bile duct system since discharge from the hospital. It is worthy of note that three of these patients died of cerebral hemorrhage.

Though apparently entirely dissociated, the common involvement of cholesterol metabolism in gallbladder disease may have atheroma as a similar expression of this impaired function. Atheromatous vascular disease with its complications of cerebral hemorrhage and coronary arterial sclerosis may represent a parallel manifestation on this basis.

SUMMARY

1. A statistical review is presented of fifty-nine cases of clinical common duct stones and thirty-three cases of common duct stones found at necropsy with and without symptoms.

2. A resumé of the need and the indications for common duct exploration is listed.

3. A follow-up review of the clinical material is discussed, showing the need for early operative interference and the urgency of common duct exploration in a large percentage of cholecystectomies.

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PERFORATED GASTRODUODENAL ULCER

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IN 1880 Miculicz performed what was probably the first surgical closure of a perforated peptic ulcer.[1] Although only simple plication was done, the patient died within three hours. This brief case history serves to introduce a subject which is of perennial interest because of its dramatic onset, well defined surgical treatment and serious potential complications.

TABLE I

Sex	Location of Ulcer	No. of Cases	Per Cent
Male	Gastric	33	30.6
	Duodenal	68	62.9
Female	Gastric	5	4.6
	Duodenal	2	1.8

The original data upon which this study is based has been taken from the records of Highland Hospital of Rochester from 1924 through 1947, providing 112 cases of which 108 patients received surgery. The cases consist of only acute intraperitoneal perforations of gastric or duodenal ulcers.

TABLE II
SEASONAL VARIATIONS

Season	No. of Cases	Per Cent
Winter	30	27.8
Spring	26	24.1
Summer	26	24.1
Fall	24	22.2

Possible etiologic factors correspond in general to figures presented in other studies. The incidence of perforated duodenal ulcer is most common in males. (Table I.) Seasonal variation has been minimal and shows no statistical significance.[2] (Table II.)

The absolute incidence of peptic ulcer in males has increased greatly according to De Bakey's analysis of 20,000 collected cases from 1910 to 1925; the increase has continued to 1940 with a relative increase in frequency of perforation.[1] Raw confirms this for the years 1937 to 1931.[3]

TABLE III
AGE GROUP

Age	No. of Cases	Per Cent
20–29	11	10.1
30–39	25	23.1
40–49	29	26.8
50–59	23	21.3
60–69	15	13.9
70–79	4	3.7
80–89	1	0.9

Ages thirty through fifty-nine show the highest incidence of perforations. (Table III.) In this series the youngest patient was twenty-one and the oldest eighty-three. Variations from these data usually appear in a more selected group such as the male series taken from the Royal Navy by Wakeley where the average age was thirty-two and the incidence of the gastric variety 54 per cent.[5]

Although difficult to classify, psychic factors such as worry and overwork, which contribute to the formation of a peptic ulcer, undoubtedly have a role in the etiology of perforation. The facts also point to the concept of overload of the stomach as an etiologic consideration. This is borne out by 30 per cent of the patients with adequate histories of having eaten within two hours of onset of symptoms.

A history of previous ulcer diagnosis or symptoms was definite in two-thirds of the 108 patients subjected to surgery. Nineteen patients gave a suggestive history, seven admitted hematemesis or tarry stools,

while six had no previous abnormal gastrointestinal history.

Without exception the onset of abdominal pain in our cases was sudden and severe. (Table IV.) Radiation occurred variously to the shoulders, generally over the abdomen, to the right lower quadrant and to the back.[3,6] Radiation to the right lower quadrant due to spread of alimentary contents down the right gutter presented the most confusing picture noted in differential diagnosis. Of the thirty-nine patients questioned concerning vomiting, 74 per cent admitted at least one emesis and about 50 per cent had repeated emesis.

Bleeding accompanying perforation has been described by many authors who state that it rarely occurs. Olson and Nogore quote Mayo as describing an avascular spot on the anterior wall of the first part of the duodenum which appears when that organ is put on a stretch. This is said to be the most common site of a perforated peptic ulcer and is probably responsible for the dictum that a bleeding ulcer never perforates and a perforated ulcer seldom bleeds. Olson and Nogore report 13 per cent of their 166 patients as showing evidence of bleeding.[7]

Physical Examination. Some of the physical findings as reported in the earlier literature have been questioned by later writers.[4,7] One of these is the early presence of shock. Olson and Nogore state that shock as measured by blood pressure and pulse determinations is not a common finding and they rely on readings of hemoglobin and hematocrit to prognosticate it.[7] Estes and Bennett report that 76 per cent of the patients in a series of 80 cases had an initial systolic pressure over 110 mm.[8] In our series only six patients had an initial systolic pressure of less than 100 mm. and the pulse was recorded as greater than 110 in only eleven cases.

In spite of the fact that many of these patients had a duration of symptoms of more than six hours, subnormal temperatures were recorded in almost one-third.

Of proven value is the finding of tenderness and rigidity of the epigastrium. All patients in this series showed rigidity of marked degree and only one had no tenderness.

Pneumoperitoneum is another sign which is universally sought in establishing the diagnosis of a ruptured viscus. Clinically, this was positive in sixteen and negative in six patients. Of thirty-seven patients subjected to x-ray study, eighteen showed free air, seventeen were negative and two were equivocal. Part of the difficulty in the demonstration of this sign may be that four or five minutes on the left side is required to allow the air which may be partially trapped to collect in a position accessible to percussion.[6] If air is sought in a vertical plane, the head of the table should be elevated at 60 degrees for physical examination but at 90 degrees for x-ray examination. Suggestions have been made regarding the deliberate introduction of air into the stomach through a Levin tube but the attendant hazard of spillage, in the opinion of several authors, outweighs the possible diagnostic advantage. Of some practical assistance may be a peritoneal tap which also has been used in combination with the placement of 1 or 2 ounces of aqueous methylene blue in the stomach.

Peristaltic sounds were absent in all of the twelve patients in whom this sign was sought. Olson and Nogore reported 72 per

TABLE IV
SYMPTOMATOLOGY

Symptom	Present	Absent	No Record	Per Cent Present
Pain				
General abdomen	107	1	0	98.9
Right lower quadrant	33	6	69	84.6
Shoulder	20	7	81	74.1
Right	13			
Left	2			
Both	5			
Tenderness	107	1	0	98.9
Rigidity	108	0	0	100.0
Liver dullness diminished	16	6	76	72.7
Vomiting	54	19	35	73.9

cent of the patients in their series had no audible peristalsis.[7] Absence of peristalsis is generally considered a reflex manifestation originating from the profound peritoneal insult of gastroduodenal leakage. The shortest time after perforation in which sounds were reported absent was one hour.

TABLE V
MORBIDITY

Cause	1924–1947	1938–1947
Pneumonia	11	1
General peritonitis	14	1
Wound infection	11	2
Miscellaneous	19	7
Wound disruption	5	2
	60	13

Laboratory Aids. Reference has already been made to the use of x-ray and the determination of hematocrit and hemoglobin. The laboratory test which is most frequently sought is the total leukocyte count. In this series seventy white blood cell counts were done; of these only six were less than 10,000.

Diagnosis. Because of the lack of complete records in the earlier cases, it is hard to say how many perforated ulcers were originally misdiagnosed. Other series have run from 5 to 15 per cent, the most common confusion existing with acute appendicitis and acute pancreatitis. It is suggested that peritoneal tap with analysis for free acid and amylase would be a harmless and frequently informative procedure in doubtful cases.

TREATMENT

Medical Treatment. Medical treatment has been reported in selected cases which correspond somewhat to the ruptured appendix seen after delay. According to De Bakey minimal qualifications for nonoperative treatment are symptoms of at least twelve hours' duration, when the patient feels improved and is able to rest comfortably and the abdominal findings are not marked.[1] In 1946 Taylor reported a series of twenty-eight cases with medical treatment.[9] The only cases in which he advises surgery are those in which there is a history of food ingestion in the period immediately antedating perforation. His argument is based on the concept that the ultimate sealing agent in the closure of any viscus is the formation of fibrin plugs. When sutures are used, the small openings beside the suture material are plugged by fibrin. Along with most other surgeons he has had the experience of finding a perforation so well sealed off at the time of operation that the site was not disturbed. Evidently the patient was curing himself and was subjected to the additional hazard of useless operation. In his series there were four deaths. Of these three were due to unassociated medical conditions. The fourth was the case of a man who had ingested two bottles of beer prior to the onset of symptoms. It was thought that this addition to the normal fasting gastric contents was enough to promote the severe general peritonitis of which he died.

Surgical Treatment. All treatment has one object in common, to close off the perforation. The technic most commonly used in the United States is plication, usually with reinforcing sutures which anchor a free or living tab of fat over the closure.[10] This method was used in ninety-seven of the surgical cases in this study.

According to Neiss, Von Haberer in 1929 performed the first recorded gastric resection for perforated ulcer.[11] Large series of European statistics apparently indicate two unique conclusions, the high incidence of reperforations and the low mortality of primary gastric resection.[12] Yudin is said to have had a series of 673 cases with a mortality of 9.8 per cent and a mortality of 6.6 per cent in the last 121 cases.[11]

In spite of good reports from some surgeons in this country, any addition to the simplest type of repair is generally regarded as injudicious. In this connection

Graham states, "There is no place for resection or anastomosis."[13]

The consensus of present day authors is that the peritoneal cavity should not be drained. Citing eighty-nine cases, McCabe and Mersheimer found the mortality to be 31.8 per cent for those drained as opposed to 22.4 per cent for those not drained.[11] It should be taken into account that those drained were probably victims of more diffuse peritoneal soiling than the others.

Anesthesia. Inhalation anesthesia was used in sixty-nine of our cases, spinal with or without supplement in twenty-two and local with or without supplement in seventeen. Spinal anesthesia or comparable relaxing agents such as tubocurarine are desirable but demand considerable judgment in their use. Graham strongly advocates spinal anesthesia whenever possible, basing his opinion on studies which have shown that less vigorous respiratory movements result in a diminished soilage of the peritoneal cavity.[13] He also mentions that following spinal it is not unusual for free air to become trapped under the diaphragm where it may show in x-ray for periods up to six weeks. This may be confusing if reperforation or subphrenic absess is suspected.

Local anesthesia is the method least compromising for poor risks. In the majority of our cases this had to be supplemented by nitrous oxide inhalation.

Chemotherapy. Chemo- and antibiotic therapy have been in general use for only the past ten years; 54.3 per cent of the patients treated during this period received one or more of these agents. To be of statistical significance regarding the value of any one of these drugs many more cases and data would be necessary.

Complications and Mortality. Postoperative complications were common, occurring in sixty cases. General peritonitis, wound infection and pneumonia, respectively, were the most frequent.

Hospital days per patient averaged 23.4 for the surgical series, being reduced to 18.6 if only the past ten years were observed. Recent figures quoted by McCabe and Mersheimer were 28.14.[11]

The over-all mortality for the 108 cases was 19.4 per cent. (Table VI.) Considering only the last 10 years, the mortality was 2.9 per cent. Of the four patients treated medically, all of whom were considered hopeless, three died. The figures for the surgical cases compare favorably with any reported, the average being somewhere between 5 and 15 per cent for the past ten years.[14,15]

TABLE VI
RELATION OF MORTALITY TO DURATION OF SYMPTOMS

Hours	Patients	Days in Hospital	Died	Mortality
1924–1947				
1–6	58	23.9	5	8.6
6–12	24	19.7	2	8.3
12–18	8	20.5	4	50.0
18–24	8	20.0	4	50.0
24 plus	7	32.0	5	71.4
	105*	23.4	20	19.4
1938–1947				
1–6	24	20.1	0	0
6–12	8	20.0	0	0
12–18	2	21.0	1	50
18–24	1	6.0	0	0
	35	18.6	1	2.9

* No history of duration of symptoms in three cases.

Extended Prognosis. Unfortunately, follow-ups of the cases in this study are almost completely lacking. Estes and Bennett discovered that 22.8 per cent of eighty cases eventuated in surgery or hospitalization for relief of symptoms.[8] Illingworth, Scott and Jamieson with 733 cases report that 40 per cent of the patients had a return of symptoms within one year; of these one-half were mild and one-half severe.[16] Major complications leading to surgery occurred in 20 per cent over a five-year period.

Wakeley in a survey of 103 cases in the

Royal Navy found that 44 per cent of these men were still serving from nine to twenty years postoperatively.[5] On this evidence he says that the prognosis is better than in any other type of ulcer complex.

TABLE VII
ANTIBIOTIC THERAPY (1938–1947)

	No. of Cases
Penicillin	5
Sulfadiazine	0
Sodium sulfadiazine	3
Sulfathiazole	5
Sodium sulfathiazole	3
Sulfapyridine	0
Sodium sulfapyridine	1
Sulfanilamide	5
	22

Illingworth, Scott and Jamieson believe that the over-all mortality rate for the group which survived the initial hospitalization was markedly increased over the standard figures for ulcer patients. In general the prognosis was found to be best in older patients with a short dyspeptic history.

COMMENTS

The figures presented in the series from this hospital are indicative of those which may be expected from any private hospital in which patients are more likely to be seen early in the course of the illness and receive treatment at the hands of a relatively small group of surgeons. Especially considering the moderate use of antibiotics in the group from the last ten years, the decrease in mortality of this once dread abdominal catastrophe is now most satisfactory (Table VII).

Accurate diagnosis is the first concern. This usually can be made clinically and verified by laboratory and x-ray findings. Methods such as peritoneal tap are secondary and will be resorted to only occasionally or as a matter of academic interest.

It is important to realize that while the diagnosis is being made or verified, the general condition of the patient should be attended to in view of impending surgery. This will include gastric suction, parenteral fluid replacement and treatment of approaching or established shock. Antibiotic therapy will usually be started in the preoperative period. The more emphasis placed on these concepts, the less important will become the elapsed time between onset of symptoms and surgical closure.

Among the points to be kept in mind during the operation is the possibility of multiple perforations. When surgery other than plication is indicated, as with pyloric obstruction, the judgment of the experienced operator is essential.

CONCLUSIONS

1. Data have been obtained from 112 cases of patients with acute perforated gastroduodenal ulcers treated in Highland Hospital of Rochester during the years 1924 through 1947.

2. There has been an absolute increase in the incidence of gastroduodenal ulcer and in the relative incidence of perforation.

3. Certain decades predispose to perforation.

4. Classical symptoms and signs of acute perforation still obtain.

5. True shock is seldom present as measured by blood pressure decline and pulse elevation.

6. Positioning for longer periods may increase the accuracy of finding free air in the peritoneal cavity.

7. The primary objective of treatment, medical or surgical, is closure of the perforation.

8. Extended prognosis is worse in patients with acute perforated gastroduodenal ulcers than for those with ordinary ulcers, the best prognosis being found in the older age groups with short or absent dyspeptic history.

9. Morbidity (37.1 per cent) and mortality (2.9 per cent) figures for the last decade are most encouraging.

10. The comments indicate the optimism with which these cases are now approached in spite of the duration of symptoms.

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EARLY AMBULATION AFTER SURGERY*

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EARLY ambulation after surgery has come of age as a valuable aid in postoperative management. Its maturity, however, has not been attained without certain vicissitudes during its adolescence. Throughout the period of growth and development the courage of Leithauser[1] and Shouldice[2] and the physiologic endorsement of Carlson[3] and others have been very conspicuous. The court of public opinion, habit and tradition had to be overcome. Unfortunately, their preceptors discouraged the practice but now, after observing reports and otherwise widening their sphere of investigation, they are enthusiastic advocates of the practice.

The great surgeons of the past were excellent anatomists. Surgeons today, from expanded research in physiology and because of a better opportunity to study applied physiology which have always been closely related to planning and therapy, find that increased basic knowledge in that field is shedding new light upon many of the problems in surgery. Postoperative complications may be referred to as the major problem. It is a problem of crippled physiology caused by surgical trauma, drugs, pain, pathology disorders and nervous reactions. The point of view many of us hold is that ambulation during the immediate postoperative period does more to correct crippled respiration, circulation and digestion than any other aid or drug. Patients who are ambulatory during the immediate postoperative period exhibit conspicuous improvement both subjectively and objectively for the reason that the approach to rehabilitation is more physiologic. The time has arrived for us to accept proper exercise during the immediate postoperative period as an aid to healing and to prevent complications just as we accept aseptic technic to prevent infection.

Respiratory Factors. Pulmonary secretion of fluids presents a serious problem in postoperative management. From Hilding[4] we have learned that by reflex action and the use of anaesthetic drugs an abnormal amount of mucus is produced. Furthermore he points out that from the same influences, viscosity of the mucus is higher than normal and often beyond the ability of the ciliated epithelium to move. Accordingly there is a firmly fixed mucous plug which changes the diameter of the bronchus. McMichel and McGibbon[5] have impressed upon us the effect of postural changes on lung volume. Churchill[6] has made many reports on the usefulness of the spirometer and by its use it is well established that vital capacity is reduced after surgery and during recumbency to the extent of about 340 cc. It is reduced because of pulmonary capillary congestion but returns to normal in the ambulatory patient in three days and twelve to fourteen days in the patient confined to bed. The standing position and walking during the immediate postoperative period stimulate the cough reflex. The diaphragm assumes its normal position and there is prompt expectoration of quantities of silver-colored mucus which may measure up to 12 cc. Atelectasis and other complications have been averted. No corroboration is needed to convince one of the value of walking and involuntary coughing when it is observed that convalescence closely parallels the return of vital capacity. The influence of walking and coughing on pulmonary physiology is direct; pulmonary ventilation is further helped indirectly by walking, a favorable influence on the circulation. It must be remembered that anatomically the respiratory system functions

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against the special handicap of draining uphill.

Circulatory Factors. Circulatory complications brought on by unphysiologic postoperative care are more dangerous than those complications affecting the respiratory system and, happily, the benefits of ambulation during the immediate postoperative period are even more striking. Relative circulatory stasis initiated by surgical trauma and intensified by prolonged bed rest leads to peripheral circulatory collapse of varying degrees, thrombophlebitis, phlebothrombosis and consequent embolism for the reasons that blood volume is lost and circulation time is longer. We are obligated to de Takats[7] and his co-workers who reported in 1943 and 1945 their work on coagulability of the blood. They believe that at the site of trauma an enzyme, presently referred to as thrombokinase, is liberated from the tissues and is an active thromboplastic agent in the production of thrombin, an insoluble protein not found in normal blood and believed to be essential to the clotting mechanism. It is equally interesting to know about the studies of Baker and Sedwitz[8] on venography of the lower extremities. These studies illustrate how quickly the material is shunted out of the deep veins after walking and how slowly it moves in the absence of muscular activity.

According to Cutler[9] these dysfunctions initiated by metabolic and reflex changes following surgical trauma are present during the first twenty-four hours. Barker[10] reports one case of fatal pulmonary embolism which occurred during the first postoperative day. Our wish, therefore, is to emphasize that too long a bed period is a conspicuous feature in the development of the thromboembolic syndrome. If bed rest is so favorable an influence to the development of circulatory complications, we should not hesitate to utilize simple walking during the immediate postoperative period as a procedure that reduces and almost removes circulatory complication. Anticoagulants, prophylactic ligation, bandages and bed exercise are poor substitutes. As far as our experience goes there are few physiologic and anatomic reasons for not walking during the immediate postoperative period.

TABLE 1

	Cases	Threatened Atelectasis	Atelectasis	Thrombophlebitis	Phlebothrombosis	Deaths
Leithauser	2,547	2	0	3	0	14
Shouldice	3,150	0	0	0	0	1
Trice	433	0	0	0	0	0
Total	6,130	2	0	3	0	15

Table 1 illustrates a series of consecutive major operations. All patients were ambulatory during the immediate postoperative period. Postoperative complications are conspicuously reduced and the serious postoperative complication of phlebothrombosis did not occur.

Gastrointestinal Factors. The harmful effects of abdominal distention should not be accepted as an inevitable consequence of the surgical procedure but should be anticipated as a complication that greatly affects morbidity. Therefore, a plan based on better understanding of the nervous mechanism controlling intestinal motility should be made to defeat or modify it. That plan would center around the removal of inhibition to the parasympathetics. The nervous control of intestinal motor function is complex. This control is mediated through the myenteric plexus and the autonomic nervous system, the former exerting the greater influence. While motility may be restored independently of the autonomic nervous system, under ordinary conditions

FIG. 1. This photograph of a sixty-six year old man who had a Miles' resection was taken during the fifth postoperative hour. Before walking he was in subclinical shock; after walking he was much restored.

the autonomic nervous system exerts favorable influence on the myenteric plexus by removing inhibition.

The same measures used to prevent respiratory and circulatory complications apply to the digestive system, the chief one being ambulation during the immediate postoperative period. Ambulation directly restores activity to the digestive tract and indirectly reduces distention by improving respiration and circulation. It contributes to the maintenance of proper pressure relationship between the abdomen and thorax and improves muscle tone.

TABLE II

Operation	No. of Cases	Hours in Bed	Hospital Days		Complications
			No.	Average per Patient	
Herniorrhaphy...	67	0	234½	3.5	0
Appendectomy...	20	0	60	3	0

In ambulatory patients the administration of food is guided largely by the appetite; we take that as a certain sign that motility is being restored. Enemas, therefore, are never required. Our patients are on regular food early and from better than average nutrition maintain nitrogen equilibrium which is an aid to healing.

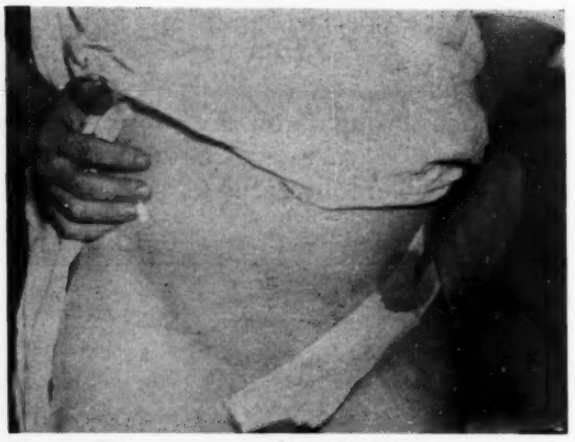

FIG. 2. Illustrates a comfortable dressing, one which does not handicap abdominal respiration.

Table II, Illustrates a number of patients who were ambulatory in the operating room. Immediate recoveries were excellent. In these cases the anesthetic agent was procaine, 1 per cent solution, with 3 mm. of epinephrine to each 30 cc. of solution. Stainless steel wire was used for suturing and ligation. Skin clips were used in the skin and removed in twenty-four hours. No narcotics were required, the capsule of aspirin and nembutal being adequate. Two of the patients with appendicitis required decompression and drainage. These two patients, we believe, required exercise earlier than the others in this table and from close observation the physiology of important systems was restored rapidly.

The practice of early ambulation has been in use since July, 1945. Patients who have been ambulatory during the immediate postoperative period have had surgery of the pancreas, bile tract, stomach, intestines, female pelvis and vagina, amputations of the lower extremities, female breast, thyroid gland and all types of hernias. (Figs. 1 and 2.)

It is our belief, as reported, that vital systems are crippled by surgical trauma. The crippling is thought to be functional and, if not halted, will lead to structural changes. All of these changes occur during the immediate postoperative period when

drugs and reactions have their maximum influence. Accordingly, the day of operation or, preferably, the first few hours after operation is the time to begin walking and not the first postoperative day. This is basic to the rationale of early ambulation for the physiologic reasons given. After the first day structural changes are well established and the influence of exercise could be harmful.

COMMENT

It is difficult to convey the extremely favorable impression made on me by the departure from a firmly entrenched routine of postoperative care. The favorable reasons for this practice do not lend themselves well to any general description which equals the experience of observing these patients. Emphasis has been directed toward physiologic considerations in surgical management, especially to a routine that prevents "deconditioning."

Contraindications to early ambulation after surgery are extremely few. Clinically, profound shock and prediction of fatal outcome are the only two; technically, unanatomic incisions and poor choice of suture material.

Infection, peritonitis, fever and moderate circulatory deficiency do not contraindicate walking. The latter circumstances do, however, involve the judgment of the surgeon.

Early ambulation restores nitrogen equilibrium promptly which shortens the lag period of healing.

Local infiltration has proved to be a very satisfactory anaesthetic procedure.

SUMMARY

1. Prolonged bed rest has been practiced because of respect for tradition and fear of complications.

2. Immobilization of surgical patients violates physiologic principles and contributes to postoperative complications.

3. Early ambulation is a logical step in the progress of surgery and offers an excellent perspective.

4. There are definite anatomic, physiologic, psychologic and economic advantages to the practice of early ambulation.

5. Review of 6,130 cases indicates that respiratory and circulatory complications have been reduced by early ambulation and voluntary and involuntary coughing.

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PROTEIN HYDROLYSATE AS ROUTINE SUPPLEMENT TO THE POSTOPERATIVE DIET*

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FOCUS of attention on correction of protein deficiency represents one of the most outstanding recent advances in the care of surgical patients. It has been shown that adequate protein nutrition is of importance in the susceptibility to shock, prevention of local or general hypoproteinemic edema, wound healing, immunity to infection and detoxication of poisonous substances. The methods of treatment for acute deficiencies such as surgical shock consist of the use of whole blood, plasma and albumin; for less acute and chronic deficiencies the use of high protein diets and protein hydrolysates. Elman and other authorities have shown that patients who receive adequate amounts of protein postoperatively usually lose very little if any weight, and have an increase rather than decrease in the level of serum albumin as compared with controls treated with the ordinary regimen.

The purpose of the present study was to determine whether it would be worth while routinely to supplement the postoperative diets at Jefferson Hospital with protein hydrolysate. It was believed that the ordinary diets administered in the surgical wards might be inadequate in protein and that routine supplementation with protein hydrolysate might produce a significant effect on the serum protein level and postoperative course of patients.

MATERIALS AND METHOD

The dietary supplement employed in this series was "aminoids." By weight, 45 per cent of this product is protein hydrolysate consisting or amino acids and polypeptides derived from animal, vegetable and milk sources (liver, beef muscle, wheat, soya, yeast, casein and lactalbumin) and 40 per cent is carbohydrate (dextrose, maltose and sucrose). One tablespoonful (9 Gm.) contains 4 Gm. of protein hydrolysate. It cannot be given intravenously but must be administered orally or through an indwelling tube.

No changes were made in the various diets which the patients ordinarily received postoperatively. Analysis of the regular surgical ward diet over a period of one week revealed a daily average of approximately 270 Gm. of carbohydrate, 80 Gm. of protein and 75 Gm. of fat and approximately 2,075 calories.

The study was started in April, 1945, and was conducted over a period of one year. There were seventy patients who received supplemental feedings and seventy control patients. The amount of protein hydrolysate administered was three tablespoonfuls four times a day, equivalent to 48 Gm. of protein. This was given orally whenever possible or through an indwelling tube during the early postoperative period.

The patients were selected so as to represent the common surgical conditions encountered in an ordinary hospital. (Table 1.) The appendectomy group was subdivided into patients with and without perforation. The biliary tract surgery included cholecystostomy for empyema and cholecystectomy with and without T-tube drainage of the common duct. Gastric and colon surgery consisted of anterior and posterior gastroenterostomy, subtotal gastrectomy for both peptic ulcer and carcinoma and right colectomy. Patients who underwent Miles resection for carcinoma of the rectum

* From the Samuel D. Gross Surgical Division of the Jefferson Medical College Hospital, Philadelphia, Pa. This investigation was aided by a grant from an anonymous donor.

were listed as a separate group. The acute intestinal obstructions were caused by postoperative adhesions, strangulated hernia and intussusception. Patients in the bar colostomy group had inoperable carcinoma of the rectum, rectosigmoid, or transverse colon. The gastrostomies were performed as palliation for carcinoma of the esophagus. All thyroidectomies in this series were performed for non-toxic goiter. The miscellaneous operations in the control and supplementally fed groups consisted of radical mastectomy, elective herniorrhaphy, closure of ruptured peptic ulcer, drainage of peridiverticular abscess and drainage of osteomyelitis. The control group was selected with utmost care so as to correspond as nearly as possible with respect to age, initial nutritional status, severity of the disease and type of operation performed. Patients with marked dehydration, shock, severe liver disease or diabetes were excluded because of the added variables making interpretation of serum protein levels more difficult.

In all instances the serum protein determinations included fractionation for albumin and globulin. These measurements were made by a turbidimetric method, using the photoelectric colorimeter. They were all personally determined as a special project by the head laboratory technician and at least half were done in duplicate. The tests were repeated approximately every other day. A total of 678 determinations were made on the control patients and 641 on the supplementally fed group, an approximate average of 9 determinations per patient. A total of 149 plasma volumes were determined in twenty-six supplementally fed patients and in ten control patients. A colorimetric method, using the dye T-1824, was used. The patients with plasma volume determinations were weighed at the time of admission and discharge.

TABLE 1
AVERAGE CHANGES IN SERUM PROTEIN LEVELS

Operations	Control Group			Protein Hydrolysate Group		
	No.	Total Protein	Serum Albumin	No.	Total Protein	Serum Albumin
Appendectomy without drainage	15	−0.5	−0.5	15	−0.1	−0.1
Appendectomy with drainage	5	+0.6	+0.1	5	+0.6	+0.2
Biliary tract surgery	9	−0.4	−0.4	9	−0.4	−0.4
Major gastric and colon surgery	10	−0.4	−0.7	10	−0.3	−0.1
Miles resection (carcinoma of rectum)	7	0.0	−0.4	7	−0.5	−0.6
Acute intestinal obstruction	5	+0.7	+0.4	5	+0.7	+0.3
Bar colostomy (inoperable carcinoma)	5	−0.2	−0.6	5	+0.2	−0.4
Gastrostomy	3	−0.1	0.0	3	−0.2	−0.1
Thyroidectomy	3	−0.4	−0.3	3	−0.2	0.0
Miscellaneous	8	−0.1	−0.1	8	0.0	−0.1
Total	70	−0.2	−0.3	70	−0.1	−0.2

RESULTS

Average changes in serum protein levels of patients in the control and supplementally fed groups between the time of admission and discharge from the hospital are shown in Table 1. For the groups as a whole the slight difference of 0.1 Gm. per cent of total protein and 0.1 Gm. per cent of serum albumin in favor of the supplementally fed group is hardly significant. The two groups paralleled each other rather closely, except for those patients who underwent gastric and colon

surgery. In this operative group the average difference of 0.6 Gm. per cent in serum albumin levels in favor of patients who received protein hydrolysate is significant. It is interesting that patients in both the control and supplementally fed groups who underwent appendectomy with drainage and operations for acute intestinal obstruction showed increases in their protein levels whereas practically all other patients showed decreases. This is due to the fact that the initial protein levels were severely depressed in these patients, and alleviation of the infection and obstruction by surgery allowed swift recovery to more normal protein levels.

TABLE II
INDIVIDUAL CHANGES IN SERUM PROTEIN LEVELS

	Control Group				Protein Hydrolysate Group			
	Total Protein		Serum Albumin		Total Protein		Serum Albumin	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Decreased	32	46	36	51	33	47	34	49
Unchanged (±0.2 Gm. %)	15	21	12	17	16	23	14	20
Increased	23	33	22	31	21	30	22	31

The number of patients whose serum protein levels increased or decreased between the time of admission and discharge from the hospital is shown in Table II. Fluctuations not greater than 0.2 Gm. per cent were considered unchanged. Comparison of these changes in the control and supplementally fed groups shows no significant differences.

The quantitative distribution of the patients' serum protein levels at the time of admission and discharge from the hospital is shown in Table III. At the time of admission the distribution of normal total protein and serum albumin levels was slightly in favor of the supplementally fed group, but this advantage was offset by a slight increase in the number of patients with very low levels. At the time of discharge, however, the percentage of normal protein levels was not only slightly higher in the supplementally fed group but the percentage of very low levels was also slightly less in this group. These findings agree with those in Table I in which the overall change in protein levels was slightly in favor of the supplementally fed group.

TABLE III
DISTRIBUTION OF SERUM PROTEIN LEVELS

Total Proteins (Gm. %)	Control Group				Protein Hydrolysate Group			
	Admission		Discharge		Admission		Discharge	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
6.0–8.0	25	36	19	27	28	40	26	37
5.5–5.9	15	21	12	17	9	13	11	16
5.0–5.4	22	31	25	36	23	33	21	30
4.5–4.9	3	4	13	19	8	11	12	17
4.0–4.4	5	7	1	1	2	3	0	0
Serum Albumin								
4.5–6.0	20	29	8	11	25	36	18	26
4.0–4.4	14	20	16	23	10	14	16	23
3.5–3.9	20	29	21	30	15	21	20	29
3.0–3.4	12	17	15	21	14	20	7	10
2.5–2.9	4	6	8	11	4	6	7	10
2.0–2.4	0	0	2	3	2	3	1	1
1.5–1.9	0	0	0	0	0	0	1	1

The plasma volume determinations did not significantly alter the interpretation of the serum protein levels in the control and supplementally fed groups and are therefore not reported.

There was no striking clinical difference in the postoperative course of the patients in the two groups. The total number of hospital days was approximately the same in each and the usual complications were noted with about equal frequency in each group. There was one instance of non-fatal wound dehiscence, however, in the control group and none in the supplementally fed group. In the group of patients weighed at the time of admission and discharge there was an average loss of 6.5 pounds in the control group and 5.8 pounds in the supplementally fed group.

The "aminoids"* were tolerated without any undue reactions by sixty patients or

* Aminoids was supplied by the Arlington Chemical Company.

86 per cent of the supplementally fed group. These patients often complained of a full feeling and needed frequent encouragement and nursing supervision to make certain that they took all of their regular hospital diet. Untoward reactions definitely related to ingestion of the protein supplement were encountered in ten patients or 14 per cent of the group. Nausea was experienced by two patients, vomiting by five and diarrhea by four. Six patients were encountered who refused to take the hydrolysate despite the utmost persuasion. Of the latter, some were used in the control group and others were excluded entirely from the series.

CONCLUSIONS

1. Comparing the control and supplementally fed groups as a whole, the slightly higher serum protein levels and questionably better postoperative course clinically in the latter group are mildly encouraging but not definitely significant.

2. The definite difference in serum protein levels in favor of the supplementally fed group following major gastric and colon surgery indicates a real need for protein supplementation but in much greater amounts than used in this series.

3. Administration of "aminoids" in the dosage and manner used in this study is not warranted as a routine procedure for all surgical cases. This is not meant to refute the well established indications for protein therapy in prophylaxis or treatment of hypoproteinemic states. There is no more justification for giving protein hydrolysates routinely than for routine administration of vitamins, antibiotics or blood transfusions.

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PREOPERATIVE BIOCHEMICAL EVALUATION OF THE SURGICAL PATIENT

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THE importance of biochemical studies on the preoperative surgical patient is a fact of accepted importance. Often the general surgeon, unfamiliar with the intricate calculations of the laboratory, is at a loss as to the proper studies necessary to determine the physiochemical harmony of the preoperative patient. It is a useless procedure to secure many laboratory studies which give irrelevant information. The purpose of this presentation is to attempt to clarify as well as to assist the surgeon in knowing what laboratory studies are necessary from a rational viewpoint.

It is an archaic procedure to study one biochemical element to the exclusion of others. By this is meant that physiologic dysfunction does not affect one aspect of blood chemistry to the exclusion of others. For this reason an intelligent evaluation of biochemical activity may be gleaned from a study of homologous related groups of blood constituents rather than from one constituent alone. This fact was clearly demonstrated in an intensive study of the physiochemical disturbance in a severe burn.[1]

In this study it was pointed out that even in the evaluation of the blood picture a simple red count is insufficient. The severely ill, surgical patient should have a hematocrit study, plus a red cell count and hemoglobin determination. With these available data the ratio of blood cells to plasma in terms of hemoconcentration and hemodilution is known. Thus a decision can be made as to whether whole blood or plasma should be administered.

A urinalysis is the next most frequent study requested by the surgeon. A solitary urinalysis often is deceiving and fails to reveal valuable information. A urinary concentration and dilution test will unfold more information as to renal function than any other single urinary study. The presence of albuminuria may be physiologic or pathologic. Albuminuria of long duration is one of the hidden causes for hypoproteinemia.

Plasma protein determination is a most important biochemical study in clinical surgery. Recent studies have unfolded many postoperative complications attributed to a lowering of the normal protein level.[2] For specific information on hypoproteineimia it is necessary to study the blood uric acid. Previous studies of this subject brought about a differentiation between hypoproteinemia secondary to insufficient dietary protein and hypoproteinemia secondary to accelerated endogenous protein depletion. This differentiation was made possible by an evaluation of blood uric acid.[3]

Blood uric acid will rise in the presence of endogenous hypoproteinemia. This results from the patient's attempts at replenishing his protein deficiency through endogenous protein secured from his own body. Clinically this state is revealed in the loss of strength and weight; chemically it can be demonstrated in an elevation of uric acid. The greater the hyperuricemia the more accelerated is the rate of endogenous protein metabolism. The reason for the hyperuricemia is the fact that uric acid is one of the end products of endogenous protein metabolism.[3] Studies of uric acid presuppose the elimination of other causes for an elevated uric acid. In order to interpret adequately the relation

between serum protein and serum uric acid both determinations must be performed simultaneously.

A frequently requested blood study is an evaluation of the urea nitrogen. An elevation of the urea nitrogen is termed azotemia. It is of three types: prerenal, renal and postrenal. The clinical surgeon is concerned with the first and third type. The postrenal type occurs when due to some extrinsic factor there is an obstruction to the passage of urine (pelvic tumors, enlarged prostate).

Greater concern is given to prerenal azotemia. The causes of prerenal azotemia are: (1) severe vomiting, especially in intestinal obstruction; (2) loss of intestinal contents as in diarrhea or duodenal fistula; (3) acute liver damage; (4) diabetic infections; (5) shock (traumatic or postoperative); (6) diffuse burns; (7) intestinal hemorrhage (alimentary azotemia).

Surgical patients presenting any of the above problems must have blood chemical studies directed at eliminating the presence of prerenal azotemia. Loss of chlorides is a major factor in the cause of azotemia. Hypochloremia precipitates an alteration in the harmonious relationship of the internal fluid balance. This causes azotemia which is readily corrected by the intravenous administration of sodium chloride solutions.

That alkalosis may produce azotemia was revealed in patients with peptic ulcer who were receiving large doses of sodium bicarbonate. Blood studies on these individuals revealed alkalosis, azotemia and hypochloremia. For this reason a carbon dioxide combining power is a valuable asset in evaluating the acid-base balance of the blood.

Current observations on salt intolerance in the postoperative patient has brought forward the deleterious effects of sodium chloride. In the light of unpublished studies the role of sodium and chloride ions in the disturbance of normal physiology has been stressed.[4] For this reason accurate chloride studies must include an evaluation of plasma sodium. These calculations will assist in the rational administration of intravenous saline solutions.

It is evident, therefore, that an intelligent evaluation of the physiochemical state of the surgical patient can be obtained only when related studies are made. Disturbances in blood chemistry rarely are solitary. Related disturbances almost always accompany physiochemical discord. When any doubt arises as to the possibility of hepatic or renal impairment, special studies should be directed at evaluation of these organs. Liver function is best studied by employing the galactose tolerance test and studying blood cholesterol in relation to cholesterol esters.[5]

SUMMARY

For an accurate determination of the physiochemical status of the surgical patient the following is advised: (1) To evaluate the blood picture employ hematocrit, red and white blood count and hemoglobin determination; (2) proper urinalysis should include specific gravity and albumin determination; (3) study of nitrogen balance implies protein determination in conjunction with uric acid value; (4) to eliminate presence of azotemia determine urea nitrogen and blood chloride estimation; (5) to rule out disturbance of acid-base balance perform carbon dioxide combining power; (6) to establish basis for water balance and for salt intolerance perform sodium and chloride studies.

The modern surgeon can no longer concern himself with the technical aspects of surgery to the exclusion of biochemical changes. The final scene in the panorama of surgical physiochemical changes has not been witnessed. No phase of clinical surgery offers greater opportunity for study than biochemical variations before, during and following surgical procedures.

By studying the biochemically related groups of the blood constituents previously mentioned, a plan is available for the intelligent evaluation of the physiochemical harmony of the surgical patient. With this

information available many disturbing complications in clinical surgery can be avoided.

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Occasionally one encounters residual stones in the common bile duct subsequent to surgery considered adequate at the time. If possible, conservative medical management should first be tried; when surgery becomes imperative, it should be as non-radical as possible. Many surgeons on finding the stones inaccessible simply insert a T tube into the common duct and thereafter instill a few centimeters of ether into it once or twice daily. Such a practice has been followed by favorable results in many cases in which surgical removal of the residual stones seemed extremely difficult or impossible. (*Richard A. Leonardo, M.D.*)

THE SMALL BOWEL ENEMA*

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THE purpose of this paper is to call attention to the importance of roentgenologic studies of the small intestine by means of the Miller-Abbott tube in the diagnosis of lesions of the small bowel and to present three cases in which the diagnosis was established by this method. The Miller-Abbott tube has been shown to be of definite value in deflation of the intestinal tract in cases of obstruction, in preoperative preparation of patients for abdominal surgery, in study of the physiology of absorption and excretion of the intestinal tract, and the tube has also proved useful as a method for providing nutrition in certain difficult cases. The long double lumen tube is now proving to be of value as an aid in establishing a diagnosis in certain obscure lesions of the small intestine.

The first report of deflation of the intestinal tract by intubation was presented by Kussmaul and Cahn[2] in 1884. Pesquera[5] in 1929 was probably the first to use a duodenal tube in roentgenologic studies of the small intestine. In 1934 Abbott[1] introduced a double lumen tube that could be passed into the small intestine. Many studies of the small bowel have been carried out since the introduction of the Miller-Abbott tube. Weltz[4] in 1939 presented many excellent roentgenologic studies of the small intestine by means of a duodenal tube. However, this method was unsatisfactory because of the length of the small intestine which resulted in overlapping of the shadows. Boon[4] reported several cases in which the double lumen intestinal tube was used in x-ray studies of small bowel lesions other than obstruction. He reported that the Miller-Abbott tube could be used in cases of partial obstruction caused by narrowing of the lumen, angulation, persistent spasm or other defects. Golden, Leigh and Swenson[2] reported that no deleterious effects resulted from the injection of barium sulfate into a Miller-Abbott tube in diseases of the small intestine. They classify their uses of the Miller-Abbott tube in small intestinal studies into: (1) paralytic ileus, (2) obstruction, (3) simple obstruction without inflammation and (4) abnormal mucosal patterns such as occur in strangulation, inflammation, malignancy and intussusception.

Many authors[2–5] previously reported using a duodenal tube for roentgenologic studies of lesions of the small intestine. Schatzki,[6] however, in 1943 first used the phrase "small intestinal enema." He did much to establish the value of this technic in discovering obscure lesions of the small intestine.

Schatzki listed several advantages of the duodenal tube as a means of examining the small intestine, namely, (1) the small intestine can be seen in its entirety, (2) actual filling of small intestinal loops can be observed roentgenologically, (3) peroral examination usually results in irregular, incomplete filling of ileum, (4) adequate examination of the ileocecal valve can be accomplished and (5) the time required for examination is shortened.

The "progress meal" of barium is frequently used in studying lesions of the small intestine. Competent radiologists are able to follow a progress meal of barium by means of the fluoroscope throughout the entire small intestine. Disadvantages of this method are that it is time-consuming usually requiring a half day or more, exposes the patient to repeated fluoroscopic examination and may be definitely harmful in cases of mechanical obstruction.

There are many patients in gastrointesti-

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nal clinics who present vague abdominal complaints and in whom after the routine roentgenologic gastrointestinal studies and other laboratory procedures no diagnosis is made. Many of these patients are told that no organic lesion is present and the symptoms are attributed to functional disturbances. Some of these patients return at a later date with a definite lesion in which the diagnosis is relatively easy. Many patients with vague abdominal complaints should have small bowel enema studies when the usual roentgenologic examination fails to reveal any organic disease. These small bowel studies can be easily carried out with the Miller-Abbott tube.

CASE REPORTS

CASE I. E. S., a fifty-four year old white male, was admitted to the Baptist Memorial Hospital with a history of epigastric pain of eight weeks' duration. The pain was sudden in onset and very severe. At the time of onset he was hospitalized elsewhere and a diagnosis of amebiasis was made. Treatment for amebiasis resulted in a disappearance of most of the symptoms. The patient was discharged from the hospital and instructed to return for follow-up studies. Upon admission to our service the patient did not appear acutely ill other than the evidence of considerable weight loss. A mass was felt in the left lower quadrant of the abdomen. This mass was approximately 3 cm. in diameter, was not tender and was freely movable. The routine blood and urine determinations were normal. A scout film of the abdomen was made which demonstrated some air in the transverse colon but this was not suggestive of obstruction. Barium enema studies of the colon were negative. A gastrointestinal series revealed an indefinite narrowing of one loop of small intestine. This finding was not diagnostic. A small bowel enema revealed a partial obstruction of jejunum suggestive of malignancy. The patient was operated upon and a tumor of the jejunum was found. A jejunal resection was done and this was followed by an uneventful postoperative course. Pathologic examination of the specimen showed it to be a carcinoid with metastasis to regional lymph nodes.

CASE II. J. N., a sixty-seven year old white male, was admitted to the John Gaston Hospital for hemorrhoidectomy. The patient gave a history of passing blood from the rectum for three years. At the onset of the symptoms three years before the patient was admitted to another institution in shock as a result of bleeding from the rectum. No cause of bleeding was found after repeated barium enema and gastrointestinal studies. The patient was discharged and readmitted to the same hospital a second time for the same condition, namely, shock from hemorrhage. Again all x-ray studies were negative.

The patient was seen in the University of Tennessee Medical Clinic two years after the first bleeding episode. At this time his complaint was that of epigastric pain. He was admitted to the hospital because of severe anemia. Repeated gastrointestinal studies and barium enema examinations were negative. The only physical abnormality was internal and external hemorrhoids. The patient was discharged and sent to the Proctology Clinic for possible hemorrhoidectomy and was hospitalized on September 14, 1948. Upon admission a mass could be felt in the right lower quadrant of the abdomen. Review of the previous gastrointestinal series failed to show visualization of the terminal ileum. A small bowel enema was done and a cystic mass was seen to fill with barium from the terminal ileum. The mass appeared to arise from the pelvis. The patient was explored and a cystic lesion was found communicating with the terminal ileum. The lesion was considered inoperable. However, a biopsy was taken and the pathologic report was spindle cell sarcoma.

CASE III. I. M., a sixty year old colored female, was admitted to the John Gaston Hospital with a complaint of cramping abdominal pain of one month's duration and enlargement of the abdomen for three weeks. Constipation had existed for six months and there were no bowel movements for one week previous to admission. There was an irregular, indefinite mass in the region of the umbilicus. Barium enema examination was negative and a scout film of the abdomen revealed some dilated loops of small intestine which were suggestive of partial obstruction. A Miller-Abbott tube was used for deflation and a small bowel enema study was done. This revealed a non-obstructing lesion in the ileum. At exploration an annular lesion was found in the mid-ileum.

This was removed and a side-to-side anastomosis was performed. Microscopic examination showed the lesion to be a carcinoid of the ileum.

COMMENT

In none of these cases was complete obstruction present. Two of the patients had been hospitalized previously and studied extensively without the diagnosis being established. Their symptoms persisted for a long period of time. All of these patients had repeated barium enema and gastrointestinal studies which were reported as negative.

We do not advocate small bowel enema studies on every patient with vague abdominal complaints. It is not believed that this means of studying the small intestine should replace methods in common use; however, it is an additional method which should be used in certain cases. We believe that patients who continue to have gastrointestinal complaints and in whom no diagnosis is made by routine studies should have small bowel enema studies.

SUMMARY AND CONCLUSIONS

1. Emphasis is placed on the importance of the Miller-Abbott tube in studying lesions of the small intestine.

2. Three cases which illustrate the value of this method in establishing a diagnosis are presented.

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ABSORBABLE STARCH GLOVE POWDER*

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SINCE the first report of a talc granuloma by Antopol[1] in 1933 an increasing number of papers have appeared cerning this serious postoperative complication. Three deaths due directly to talc have been reported.[2,3] The excellent studies of Seelig and his co-workers[2,4–7] have not only prompted surgeons to a greater appreciation of this hazard but have also stimulated and led further search for a more satisfactory substitute for talc. The characteristics of this substitute would include: (1) satisfactory flow and lubricating qualities; (2) non-reactivity in tissues, preferably by reason of rapid absorption; (3) physical and chemical stability on sterilization. (4) non-allergenic and not irritating to the skin with repeated use and (5) inexpensive and readily available.

Potassium bitartrate was found by Seelig to be satisfactory, except that this material became sticky and carmelized with oversterilization. Starch was found to gelatinize on autoclaving but this was prevented by the addition of formaldehyde. In clinical use, however, formaldehyde treated starch caused a skin reaction on the hands of surgeons although Gottschalk[8] failed to obtain positive patch tests with this material.

In a search for a satisfactory substitute for talc as a surgical glove lubricant, Lee and Lehman[9] studied a modified starch (powder 108) which has been commercially named Bio-Sorb. According to the manufacturer, Bio-Sorb is "a biologically absorbable powder prepared from cornstarch by etherification with epichlorohydrin. The starch polymer chains are presumably cross linked by 1,3 diether glycerine groups to the extent of not more than 2 per cent of the original starch weight. The starch derivative is mixed with magnesium oxide, 2 per cent, and contains small residual amounts of sodium sulfate and sodium chloride."

Lee and Lehman found complete absorption of this powder from the peritoneal cavity of dogs three weeks after operation without demonstrable reaction. Recent further studies by Alrich, Lee and Lehman[10] confirmed this. MacQuiddy and Tollman[11] observed in rabbits that "very little, if any" of this starch powder remained fifty-six days after subcutaneous implantation of 200 mg. pellets. Postlethwait, Howard and Schanher[12] noted complete absorption fourteen to twenty-eight days after the starch powder had been placed in the peritoneal, pleural and pericardial cavities, and almost complete absorption in muscle, tendon, joint and nerve of dogs. In a limited study previously reported,[12] absorption of the starch was erratic (as to time) from the rabbit peritoneal cavity and was complete in six days in four dogs. These studies of Lee and Lehman, MacQuiddy and Tollman, Postlethwait, Howard and Schanher, and also those of Naffziger, Ledwich, Marchi and McCorkle[13] with this material suggested that it was the most satisfactory substitute for talc now available, fulfilling the requisite qualifications enumerated.

The following study was carried out to determine accurately the rapidity of absorption of the modified starch glove powder number 108.

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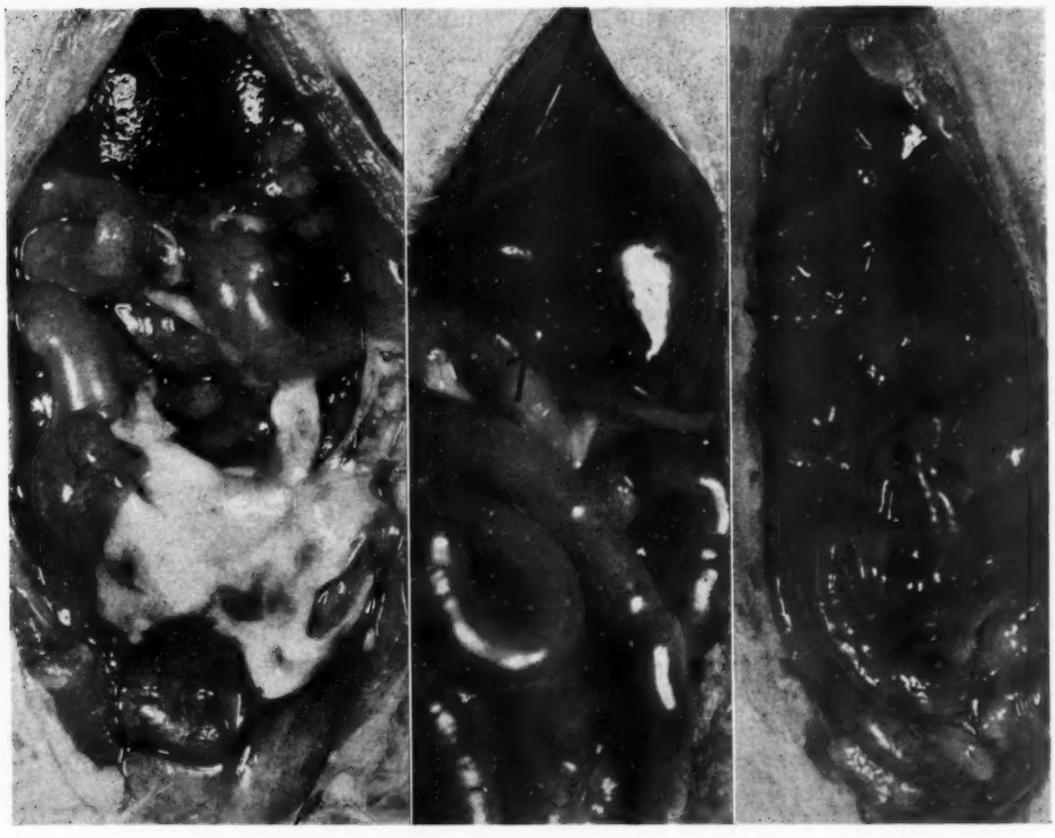

1A 1B 1C

FIG. 1. A, four days, large coalesced plaques of starch remain; B, eight days, a small plaque of starch remains on the margin of the liver; C, twelve days, no starch found.

METHOD

White rats weighing 250 to 400 Gm. were used. Under ether anesthesia and with aseptic technic, 0.5 Gm. of the starch powder* was placed in the peritoneal cavity through a short left rectus incision. Cotton closure with through and through sutures was used. At two-day intervals up to twelve days the animals were killed; forty-six rats were studied. With the abdomen opened widely, the peritoneal cavity was carefully searched by gross inspection for starch powder.

Results. In Table 1 the results are summarized. Absorption was complete in all animals opened in twelve days and the majority of those examined at ten days. No evidence of reaction due to the starch powder was noted, such as adhesions, injection, roughening of peritoneal surface, nodules or granuloma. (Fig. 1.)

TABLE 1

Days Postop.	No. Rats	Amount of Starch Remaining*				
		4 Plus	3 Plus	2 Plus	1 Plus	0
2	2	2				
4	5	5				
6	5	5				
8	12	..	2	4	5	1
10	12	..	..	..	3	9
12	10	..	..	..	..	10

* 4 plus large plaques of starch, 3 plus one or two small plaques, 2 plus small amount or one tiny plaque, 1 plus any trace of starch, and 0 no starch.

Comment. From this evidence absorption of the starch powder took place between six and twelve days after implantation in the peritoneal cavity of rats. The major portion of the starch was absorbed

* The starch powder used in this study was supplied by Ethicon Suture Laboratory, Division of Johnson and Johnson, New Brunswick, N. J.

during the early part of the period. The amount of starch powder used was the equivalent of the talc obtained by washing the outside of four pairs of rubber gloves as routinely prepared for surgical use.[9] As a comparison, the starch powder placed in the rats would approximate 100 Gm. in a 70 Kg. man. This certainly represented a dosage far in excess of any amount which might be introduced accidentally into tissues during operation.

Test for Aldebyde. Seelig[14] stated that with Bio-Sorb he "found evidence of the presence of an aldehyde of some sort upon treating with Schiff's reagent." No aldehyde is present in the starch powder, according to the manufacturer's statement, so that a positive test required further investigation. In Kamm's publication[15] precautions regarding falsely positive tests with Schiff's reagent are given. The reagent is prepared by dissolving 0.5 Gm. pure fuchsin (p-rosaniline hydrochloride) in 500 ml. distilled water, filtering and saturating with sulfur dioxide. The latter step destroys the pink or magenta color which is restored by the addition of an aldehyde. Kamm notes that a false positive is obtained with an inorganic alkali. The magnesium oxide in the starch powder is partly converted to magnesium hydroxide in sufficient amount to cause a positive test, thus explaining the erroneous conclusion of Seelig.

To test the validity of this assumption, Schiff's reagent was added to a water suspension of chemically pure magnesium oxide. A pink color developed indicating a positive test although in no way resembling the rich purplish-red obtained with dilute formaldehyde or benzaldehyde. A suspension of the starch glove powder (5.0 Gm. in 20 ml. of water) likewise gave a faintly positive test. A test of the starch glove powder *without* magnesium oxide was negative.

Seelig further stated that in earlier studies he had found magnesium oxide caused granuloma and plaque formation in tissues. While tissue reaction to sufficient quantities of undiluted magnesium oxide probably occurs, none of the workers who have studied Bio-Sorb under a variety of experimental conditions have observed failure of absorption, gross irritation or adhesion formation. Apparently the small amount of this chemical (2 per cent) contained in Bio-Sorb was insufficient to cause such reaction. To date, dogs, rabbits, guinea pigs and rats have been studied and absorption without reaction appeared to be uniform, although some variation in the time required was noted.

SUMMARY

A modified starch surgical glove powder was found to be completely absorbed from the peritoneal cavity of rats within twelve days. The starch powder does not contain an aldehyde, the falsely positive test with Schiff's reagent being due to the magnesium oxide. The latter, added to improve flow and prevent gelatinization was inadequate in amount to cause detectable tissue reaction.

Although the dangers of talc have been repeatedly pointed out, particularly by Seelig and his co-workers, this hazard has been allowed to remain in numerous operating rooms. The excuse that a substitute is not available is no longer acceptable. The starch powder suggested by Lee and Lehman has been found to be extremely satisfactory as a surgical glove lubricant both in the laboratory and in the operating room.

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G. W. Horsley reviews the effects of hormones on cancer and notes the unfavorable results of pregnancy and active ovarian function on the prognosis of breast cancers in women. Consequently, he believes, as others did before him, that best results are obtainable by supplementing radical mastectomy with castration. He tells that 40 per cent of patients are cured by the radical operation alone whereas almost double that per cent survive the five-year period if they also are subjected to castration. Surgical or x-ray castration can be performed, of course. It is my personal preference to supplement radical mastectomy with pre- and postoperative radiation of the chest and axilla and supraclavicular region; and while the patient is undergoing such radiation, it seems simpler and safer to have x-ray castration at the same time. This has been my practice for several years past and the results have been very pleasing to me. The author mentions the possible use of male sex hormones also in these cases and it may well be worth while—but as a supplement to and not a substitute for castration. (*Richard A. Leonardo, M.D.*)

Streamlined Articles

THE PROBLEM OF THE REMAINING COMMON DUCT STONE*

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A CASE is reported in which a routine cholangiogram following choledochotomy and cholecystectomy disclosed three stones still in the common duct. With the use of a biliary flush as described by Best, the three stones passed into the duodenum and were recovered from the stool. The two methods of nonoperative treatment of the remaining common duct stone are discussed with their disadvantages and merits.

* * * *

One or more stones remaining in the common duct following surgery are most frequently discovered at the time of the first cholangiogram in preparation for removal of the T tube. Occasionally the surgeon may be forewarned when the patient has a recurrence of symptoms on the first clamping of the T tube. It is more common to have the patient maintain a comparatively asymptomatic course and the presence of a stone demonstrated by the roentgenologist. There is a considerable amount of dispute as to why stones in the common duct are overlooked at the time of surgery; reliable opinion concludes that either technical difficulties make choledochotomy and exploration unsatisfactory and inaccurate or that stones in the hepatic duct and intrahepatic radicles descend into the common duct after surgery. These two conditions are excellent arguments for the use of operative cholangiograms in cases in which satisfactory exploration is technically difficult. Among some of the more general conditions that have been mentioned by other writers as reasons for leaving stones in the duct there are: the short obese patient with the deep lying common duct and considerable fat in the mesentery and around the viscera which make instrumentation difficult, palpation unsatisfactory and the examination of necessity not as thorough as one would wish; the bad-risk patient presents a definite problem as to how much of the operative time one can allocate to the ductal exploration and in some cases exploration must be hurried.

There are certain local conditions which occur in the common duct which present technical difficulties and make exploration unsatisfactory. The presence of a short common duct or a short segment between the cystic duct and the point at which the common duct disappears from view behind the duodenum offers considerable impediment to the easy passage of scoops, probes and dilators through the course of the common duct into the duodenum. The presence of an anomalous hepatic artery crossing in front of the common duct[1] has somewhat the same effect as a short common duct, forcing the surgeon to open the common duct within certain narrow limits and making exploration of the right and left hepatic ducts difficult. Thickening of the head of the pancreas, the result of chronic inflammation, interferes with palpation of this portion of the common duct and the probe may pass into the duodenum and the thickened tissue prevent satisfactory palpation of the duct against the probe. It

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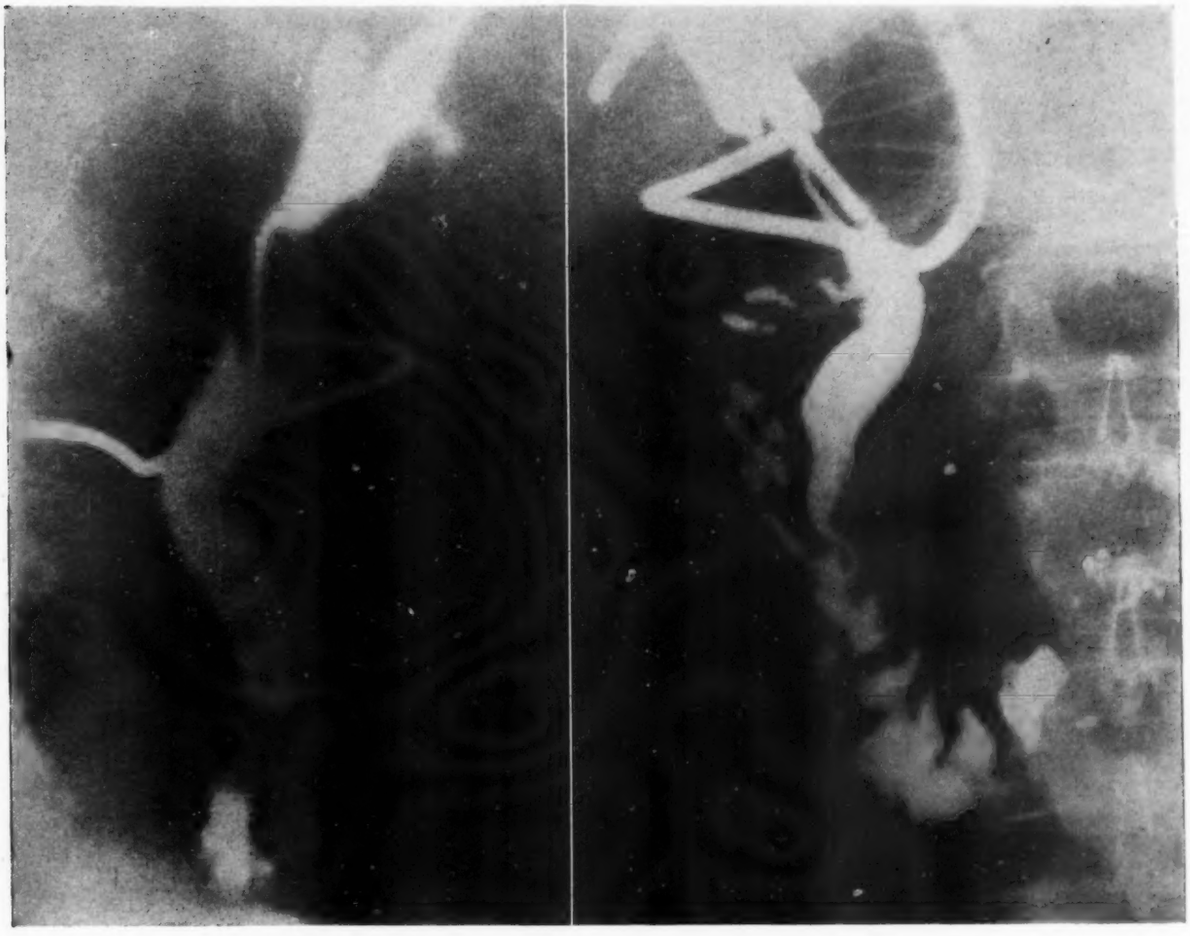

1 2

FIG. 1. Postoperative cholangiogram demonstrating three shadows in the common duct indicative of calculi.
FIG. 2. Cholangiogram after biliary flush, with disappearance of shadow of three stones.

should be recognized that the passage of a probe or scoop along the common duct into the duodenum does not rule out the possibility of a common duct stone. Stones may erode into the wall of the duct, forming a pocket, and become impacted and the probe will pass satisfactorily without evidence of obstruction. Stones impacted in the region of the ampulla of Vater are among some that are commonly missed. Exploration of the right and left hepatic ducts is not usually as satisfactory as the common duct and for this reason most surgeons resort to flushing with saline in an attempt to dislodge any stones that may be present. It has been thought by many that the overlooked stone frequently comes down from the right or left hepatic duct. The fact that the stone in most cases lies between the T tube and the ampulla of Vater, as demonstrated by the cholangiogram, would place some question on this fact. It is recognized by the writer that certain surgical maneuvers aid in overcoming the problems just mentioned such as the Kocher mobilization of the duodenum and exposure of the pancreatic portion of the common duct and supraduodenal exploration of the ampulla of Vater

The method of handling the problem of the remaining common duct stone rests to a great extent on the presence of a T tube in the common duct. If it has been removed, surgery is the only method of treatment available. In the presence of a T tube in the common duct one of the nonsurgical methods should be given a trial before operation is resorted to. There are

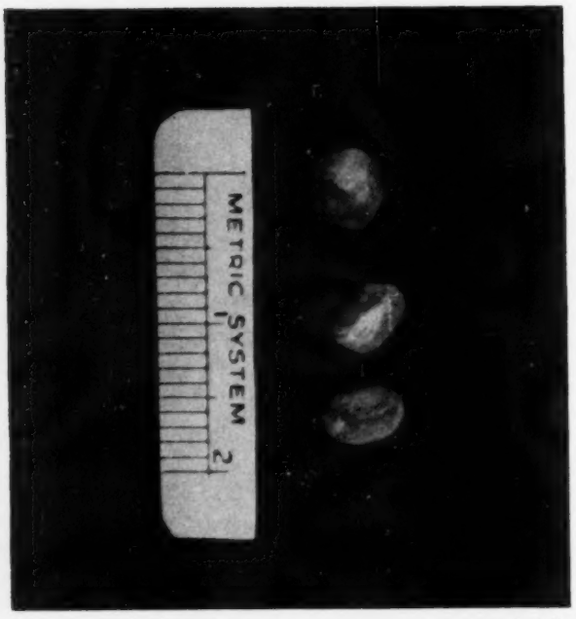

FIG. 3. Common duct stones recovered in stool following biliary flush through T tube.

two non-operative methods of handling the remaining common duct stone: (1) fragmentation and expulsion with ether; and (2) biliary flush. In 1933 and 1936 Pribram[2] demonstrated that gallstones contain a certain amount of cholesterol in their architecture and that cholesterol is soluble in ether. The erroneous idea has become associated with this method that the increased pressure caused by the vaporization of the ether in the common duct forces the stone through the ampulla into the duodenum. It is the slow dissolution of the stone into fragments that gives the desired results with this method. There are two disadvantages with this method of treatment, namely, the alarming abdominal symptoms that are occasionally produced in the patient by the introduction of ether and the length of time required to fragment and dissolve certain types of stones. The time required for successful trial of treatment is occasionally prolonged as some of the stone contains large amounts of calcium which are insoluble and the speed of dissolution is somewhat proportional to the amount of stone surface that comes in contact with the solvent.

Because of these apparent difficulties Best[3] developed a method which he calls biliary flush and which depends most on the flushing action of warm olive oil and relaxation of the sphincter of Oddi. This method has certain advantages as it can be used quite satisfactorily through a T tube and is not painful to the patient. Amyl nitrate and other drugs are used to produce a relaxation of the sphincter of Oddi. Nupercain and other novocain derivatives have been used successfully as a flushing agent by Harris and Marcus[4] and others.

There is a scarcity of reports in the literature on the frequency of a stone remaining after common duct exploration. The various estimates are placed at between 10 and 18 per cent. In many of these cases the patients are reoperated upon because of a persistent biliary fistula or a return of symptoms and are, therefore, not reported.

CASE REPORT

Mrs. N. B., sixty-four years old, was admitted to St. Vincent's Hospital on January 28, 1947, with a diagnosis of cholelithiasis and possible choledocholithiasis. She gave a history of pain in the right upper quadrant of the abdomen following the ingestion of fatty foods for the past thirty years. There was no history of jaundice, chills and fever or clay-colored stools. The past history was essentially negative. She had had two normal pregnancies. She had been operated upon previously for a urinary bladder stone.

Physical examination revealed an obese female who was not uncomfortable. Her temperature was 98.8°F., blood pressure 175/90 and pulse 76. There was no evidence of icterus. Examination of the head was negative; the pupils reacted to light and accommodation. The mouth was edentulous and the tonsils were small and atrophic. The chest was emphysematous in type, expansion somewhat limited, and both lung fields were clear. The breasts were pendulous and the nipples were retracted; there was no evidence of tumor. The abdomen was obese and there was a midline surgical scar below the umbilicus. The gallbladder and liver were not palpable; there was slight tenderness in the right upper quadrant. The remainder of the abdomen was negative to examination. On vaginal examination the uterus was small and

the tubes palpable. Rectal examination was negative.

Laboratory findings were as follows: red blood cells 3,800,000; white blood cells 6,200; hemoglobin 12.6; urinalysis negative; prothrombin 73.5; Wassermann negative; nonprotein nitrogen 32; sugar 108; electrocardiogram showed premature ventricular contraction. X-rays showed multiple stones in the gallbladder; there was no evidence of myocardial damage.

The patient was operated upon February 5, 1947. The abdomen was opened through a right rectus incision and exploration revealed the presence of a small contracted gallbladder filled with stones of varying sizes. The cystic duct was dilated and there was a stone impacted at the junction of the cystic and common ducts. The liver was smaller than normal, firm and deep red; the surface was granular, suggestive of an early cirrhosis. The stomach and duodenum were normal. Inspection and palpation of the pancreas showed a small organ freely movable; there was no evidence of inflammation. The large and small bowels were normal. The uterus and pelvic organs were small and atrophic. The common duct was enlarged and a stone could be palpated. The bile from the common duct was clear and green.

The duct was opened and explored and a single stone was removed. A T tube was sutured into the common duct, the gallbladder was removed and the abdomen was closed. The patient was given 500 cc. of blood during surgery and her immediate postoperative condition was satisfactory. The postoperative course was uncomplicated and the drain was removed on the third day; the T tube was clamped on the fourth postoperative day. On the twelfth postoperative day a cholangiogram was made before the T tube was removed. It revealed the presence of three shadows in the common duct distal to the T tube, indicative of stones. It was decided to try a biliary flush to see if the stones would pass into the duodenum. The following three-day regimen was instituted: 3 gr. decholin three times a day; $\frac{1}{100}$ gr. nitroglycerin three times a day; at the time the T tube was flushed with warm olive oil and magnesium sulfate (2 ounces) at 7:00 A.M. and cream (2 ounces) at 8:00 P.M. The T tube was clamped shut except for the instillation of 40 to 50 cc. of warm olive oil daily. On the second day $\frac{1}{300}$ gr. atropine was given in place of nitroglycerin. On the second day of the treatment one stone was recovered from the stool and on the third day, two stones. Repeat cholangiograms the following day showed a normal gallbladder and bile ducts. The T tube was removed and the patient was discharged from the hospital. One year later the patient was symptom-free. (Figs. 1 to 3.)

It is believed that more frequent use of mobilization and exploration of the retroduodenal portion of the common duct and the use of operative cholangiograms would reduce the incidence of this complication.

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PRIMARY IDIOPATHIC SEGMENTAL INFARCTION OF THE GREATER OMENTUM*

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A REVIEW of this subject leads to the conclusion that spontaneous infarction of the greater omentum is a rare surgical lesion which, with few exceptions, simulates acute appendicitis. In eight of the ten cases reported appendicitis was the preoperative diagnosis. With that preoperative impression the real lesion may not be found during operation unless the omentum is thoroughly explored. The failure to diagnose and remove this pathologic lesion may lead to adhesions and unexplained abdominal symptoms. The etiology of this lesion is obscure but the almost constant location of the infarct suggests to us that some anatomic peculiarity of the venous drainage of the omentum, predisposing to thrombus formation in its lower right portion, may be a contributing factor.

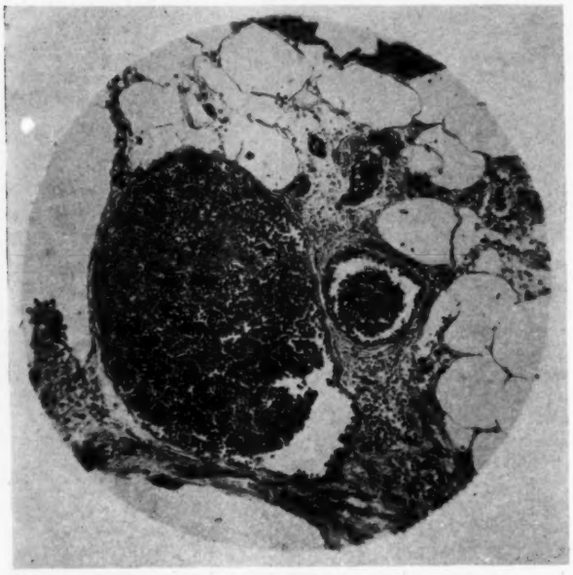

FIG. 1. Photomicrograph of infarcted area of omentum showing a recent hyalin thrombus in a vein; also extravasation of erythrocytes and neutrophiles; × 200.

* * * *

The disturbance in nine of the ten cases was notably similar.[1–3] It consisted of a hemorrhagic infarct of the distal edge of the omentum on the right side. In one case the infarct was described as radiating from the greater curvature of the stomach.

As one would expect from the location of the disorder, the signs and symptoms of this lesion are usually not distinguishable from acute appendicitis. A preoperative diagnosis of acute appendicitis was made in eight of the cases and was mentioned in another in which the first impression was subacute perforated peptic ulcer. In the remaining case in which the infarction was near the greater curvature of the stomach the preoperative diagnosis was perforated duodenal ulcer. All of the cases diagnosed as acute appendicitis exhibited pain, tenderness and muscle spasm in the lower right quadrant occasionally associated with some indigestion. In the remaining two cases the signs and symptoms were localized in the para-umbilical or epigastric region. Vital statistics and laboratory studies were fairly constant and consistent with a diagnosis of acute appendicitis. The patients were twenty-seven to sixty-three years of age and equally distributed between both sexes.

At operation the diagnosis is not difficult to make if proper exploration is carried out when the condition of the appendix or another suspected organ is not consistent with the signs and symptoms. The omentum presented a picture of hemorrhagic infarction with varying degrees of gangrene in several specimens. The involved portion was adherent to the anterior abdominal wall in about half of the cases. An excess of peritoneal fluid or serosanguineous fluid was observed occasionally. The appendix

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was never found closer than several centimeters from the involved portion and was never acutely inflamed.

The treatment consisted of excision of the involved omentum except in one instance[4] in which the infarction was found in its proximal portion. An incidental appendectomy was performed in all but three cases. The abdomen was closed without drainage except in that instance in which the involved omentum was not removed. Convalescence was uneventful in all cases.

CASE HISTORY

A fifty-four year old, white woman was admitted to Jefferson Hospital with the chief complaint of abdominal pain. Two days previously a sudden, severe, non-radiating pain had developed in the lower right quadrant of her abdomen. It persisted in varying degrees of severity but was not severe enough to confine her to bed. Self-administered enemas failed to alter the pain. There was no nausea, vomiting or change in bowel habit. She denied any history of straining, coughing, sneezing or abdominal trauma prior to onset of the pain.

Her previous medical history was negative except for mild hypertension and moderate constipation of several years' duration.

Positive physical findings consisted of a slight enlargement of the heart, blood pressure 160/100, tenderness, rebound tenderness and muscle-guarding in the lower right quadrant of the abdomen. A blood count and urinalysis at the time of the admission were normal.

A preoperative diagnosis of acute appendicitis was made and the operation performed soon after admission. Upon entering the peritoneal cavity a small amount of serosanguineous fluid was observed. The appendix appeared to be normal but an area of infarction approximately 3 by 4 cm. in the lower right edge of the greater omentum was found loosely adherent to the anterior abdominal wall. Thorough exploration revealed no other disorder. The involved portion of the omentum was widely excised and an incidental appendectomy performed. The abdomen was closed without drainage.

The operative diagnosis of primary idiopathic infarction of the greater omentum was confirmed by pathologic examination.

After an uneventful postoperative convalescence the patient was discharged on the tenth postoperative day. One month after discharge comprehensive studies to determine any abnormality of the clotting mechanism were all within normal limits. Two and a half years after operation there was no recurrence of symptoms.

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CONSTANT PRESSURE SCALP DRESSING*

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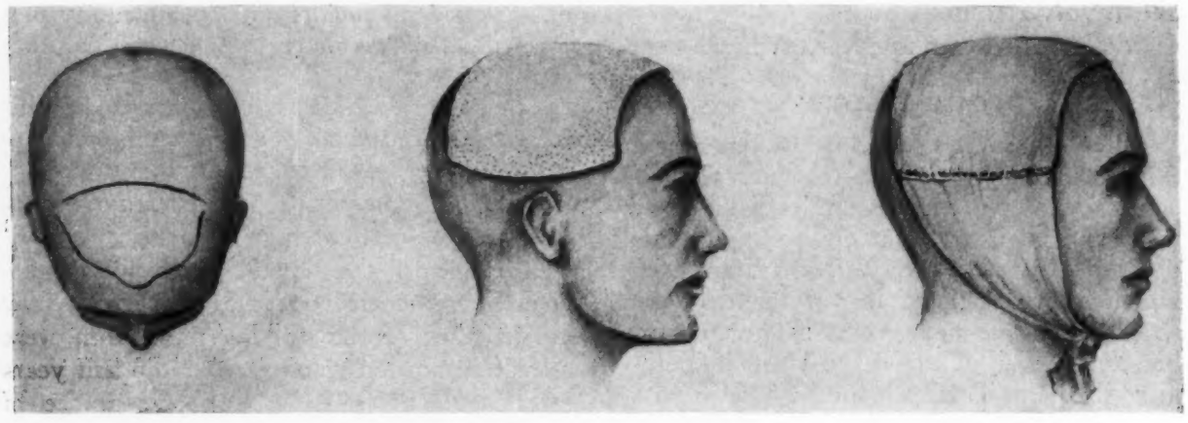
OCCASIONALLY it is necessary to have equally distributed constant pressure to the scalp. One frequently sees head injuries with associated extensive scalp tears. Patients so injured may be in various stages of confusion resulting from concussion. It is in this type of case that a constant pressure scalp dressing may have a place because in addition to the desired pressure, it is almost impossible for a confused patient to remove the dressing himself.



1 2 3

FIG. 1. Extensive laceration, roughly resembling a large D, with flap completely avulsed except for two small attachments.
FIG. 2. Thin strips of gauze are applied and held secure by sea sponge following suture of scalp edges.
FIG. 3. A piece of muslin is attached to each end of a cuff of a rubber glove, the ends of which are tied under chin for tension.

* * * *

CASE REPORT

A thirty-six year old, white male, fell while attempting to board a moving train. He was momentarily unconscious and on admission to the hospital appeared somewhat confused. The confusion, however, was in part due to language difficulty and not entirely the result of injury.

Examination revealed a compression fracture of the bodies of the eighth and ninth dorsal vertebrae. There was an extensive laceration of the scalp extending down to the epicranium. The laceration roughly resembled a large "D" and the flap measured 10 by 15 cm. The flap was completely avulsed except for two small attachments which were 1 cm. and 2 cm. respectively. (Fig. 1.) It appeared that these attachments would not be sufficient to furnish blood supply to the flap and that actually the repair would be a full-thickness skin graft. Preparation and shaving of the surrounding scalp and flap were difficult. It was feared that during the process the flap would become completely detached. To avoid this possibility the flap was secured to the scalp in several places with towel clips. The area was shaved and cleansed with soap, water and normal saline washes. The flap was then carefully sutured to the scalp edges using fine black silk. Thin strips of gauze were applied and held secure by a sea sponge. (Fig. 2.) A cuff of rubber glove to which a piece of muslin had been stitched on each end was applied and the ends tied under the chin so that a moderate degree of tension could be maintained. (Fig. 3.) A piece of stockinet was put on the head and a thin cap of plaster applied, making sure that

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4 5 6

FIG. 4. A stockinette and a thin cap of plaster are applied, extending well down on the orbital ridge in front and to the external occipital protuberance behind.
FIG. 5. After the plaster has hardened, pieces of muslin are untied under chin, brought back up on top of the head and secured with a safety pin.
FIG. 6. Another thin layer of plaster completes the dressing.

it extended well down on the orbital ridge in front and to the external occipital protuberance behind. (Fig. 4.) This was done to assure good fixation of the cap below the greatest circumference of the head. After the plaster had hardened, the knot below the chin was untied. Care was employed not to relax the tension and the pieces of muslin were turned back on the top of the head and secured with a safety pin. (Fig. 5.) The redundant edges were cut away. Another thin layer of plaster completed the dressing. (Fig. 6.)

The wound was left undisturbed for eleven days; the cap was then removed. The skin of the flap was in excellent condition and the edges had healed beautifully.

The patient in this particular instance had a laceration of the center of the scalp. However, injuries to the occipital or frontal areas can be managed in the same manner. If the wound is in the occipital region, the pieces of muslin are tied below the nose; if the injury is in the frontal area, the pieces are tied at the back of the neck.

Case Reports

PLANTAR INTERDIGITAL NEUROMA OR MORTON'S TOE*

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THIS is to represent a not too uncommon condition of the foot which is painful and at times disabling to the patient; a condition that can usually be relieved by surgery. It is known as plantar interdigital neuroma or Morton's toe.

Thomas Morton originally described this condition in 1876 at which time he suggested that it was an affliction of the fourth metatarsophalangeal joint or a pinching of the digital branch of the lateral plantar nerve by the head of the fifth on the neck of the fourth metatarsal bone. Since that time the condition has been frequently described but it remained for Letts in 1940 to stimulate its contemporary interest. He advanced a more sound etiologic theory which was a stretching and irritation of the fourth digital nerve. This nerve differs anatomically from the other plantar nerves in that it has a double origin—a branch from the medial as well as the lateral plantar nerve.

In a review of the literature it was noted that Thomas Morton described a surgical procedure for the alleviation of this condition, the excision of the fourth metatarsophalangeal joint. His description of the procedure is interesting for he emphasized the necessity to "excise all adjacent soft parts to insure excision of all surrounding nerve branches." These last two words, "nerve branches," suggest the reason for his cures.

Mills in 1888 and Hoadley in 1893 stated that the fourth digital nerve was the involved nerve, not the fifth as suggested by Morton. Hoadley was the first to suggest that the nerve be removed but made no report of nerve resection. Hoadley in his report also suggested that a tear in the transverse ligament depressed the fourth metatarsal head and thus initiated the irritation to the digital nerve. The history of trauma arose frequently in the case reports of the older literature but has been discounted or overlooked by contemporary authors. This might bear farther investigation.

Sir Robert Jones and A. H. Tubley in 1898 noted there was a neuritis of the digital nerve and mentioned its double origin. Both are points of significance, as will be shown later, but their importance was not realized. These men condemned the resection of the digital nerve as a dangerous procedure.

It can be seen that by the work of the aforementioned physicians all the essential elements of plantar interdigital neuroma, or Morton's toe, were known by 1898. This did not, however, detract from the work done and reported by Betts of Adelaide in 1940, and by McElvenny of this country in 1943; for it was these men, working independently of each other and who, by correlation of anatomy, physical and operative findings, gave us our present concept of this pathologic condition of the foot.

ETIOLOGY

The etiology, according to Betts, can be simplified into a few words, namely, a stretching or irritation of the fourth digital nerve due to its anatomic peculiarity. In 1948 K. I. Nissen of England presented an

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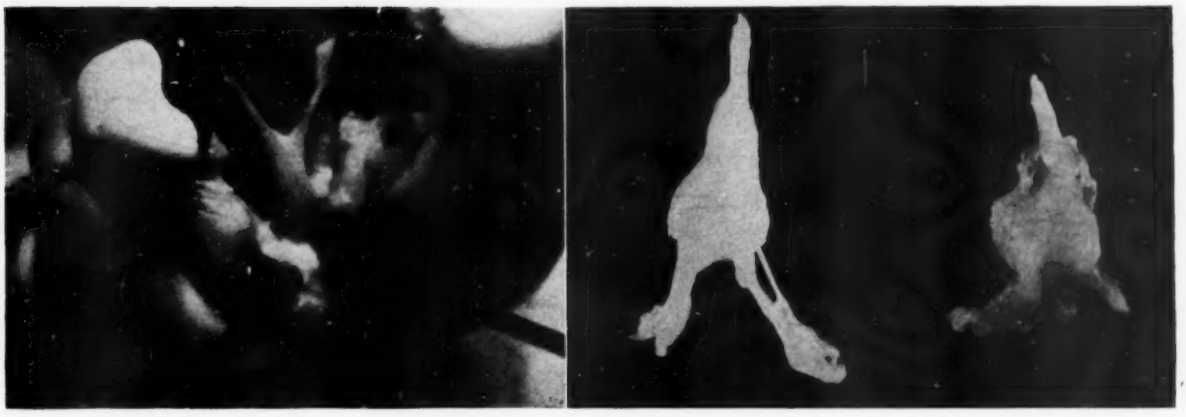


1 2

FIG. 1. Photograph of a plantar interdigital neuroma *in situ* demonstrating the fusiform swelling just proximal to the terminal branches of the nerve.
FIG. 2. Photograph of a case of bilateral plantar interdigital neuroma after removal.

article that supported the general conclusion of Betts but suggested a different primary etiology for the neuritis.

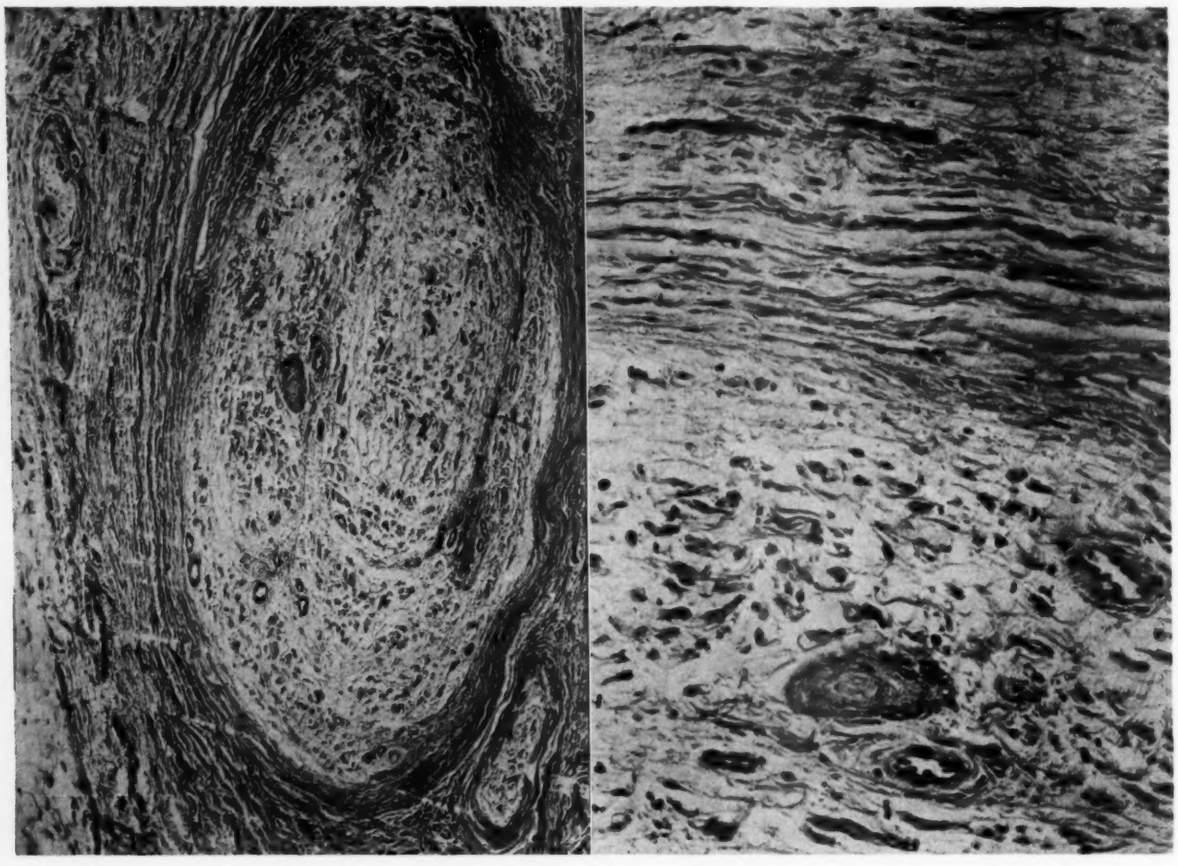
Betts suggested the following as the etiologic factors leading to plantar neuroma of the fourth digital nerve: (1) The fourth digital nerve arises from an anastomosis of a branch from the medial plantar nerve and a branch from the lateral plantar nerve. This is different than the other digital nerves which branch from either the lateral or medial plantar nerve. (2) The nerve, because of its double origin, is surrounded by more sheath. This enlarges the diameter of this certain nerve. (3) The branches from the lateral and medial plantar nerves come from above, down and around the belly of the flexor brevis muscle to join into a single nerve. This then crosses the transverse ligament to divide and supply the lateral side of the third toe and the medial side of the fourth toe. Thus, when the flexor brevis contracts, as in walking, the origin of the nerve is fixed; and with the toes in dorsiflexion the nerve is subject to stretching and trauma as it passes over the unyielding transverse ligament. Therefore, a local neuritis is evoked with swelling. This leads to more stretching and swelling, completing the vicious cycle.

Nissen contends that the etiologic factors leading to plantar neuroma of the fourth digital nerve are not only those presented by Betts but that the primary lesion is one of local vascular degeneration leading to a wide variety of changes in and around the nerve. In discussing the anatomy, he points out: (1) The communicating branch from the lateral plantar nerve, which is important to Bett's theory, is frequently absent. (2) The artery supplying the third interspace is sometimes absent and a branch from the artery supplying the second interspace must cross the common flexor sheath for the third toe in order to reach the nerve, thus making the artery particularly liable to pressure transmitted through the sole. (3) The micropathologic examination shows the digital artery to have advanced degenerative changes. These changes, he believes, are the primary lesion.

Nissen does not advance the reason for the degenerative change in the digital artery of the third interspace. In his opinion the arterial supply to the digital nerves are of paramount importance when compared to larger nerve branches elsewhere in the body since these larger branches always have a good anastomatic arterial supply which protect them from ischemia.

CASE REPORT

Patients in this group with pain or disability enough to warrant operation numbered four. All were females between the ages of twenty-nine and fifty-four. One case exhibited bilateral involvement. Be-



3 4

FIG. 3. A low power photomicrograph of a plantar interdigital neuroma showing increase in the fibrous connective tissue, thickening of the perineurium, degeneration of the nerve fibers and infiltration about these fibers with fibrous connective tissue; × 10.

FIG. 4. A high power photomicrograph; the perineurium shows fibrotic and hyalin changes which markedly thicken the whole structure; × 40.

cause of the similarity of these cases as to their subjective symptoms, only one will be presented. (Figs. 1 and 2.)

R. G., a white female, age fifty-one years, a school teacher, was admitted February 28, 1949. The patient gave a history of ten years' duration. It consisted of sharp, lancinating pain over the head of the fourth metatarsal. The attacks of pain came suddenly and were relieved by removing the shoe and massaging the foot. She had sought relief with orthopedic shoes, metatarsal bars and supports without the desired results.

On physical examination of the foot, tenderness on pressure could be elicited in the third interspace. Compression of the foot in the region of the metatarsal heads caused pain in the third interspace. There was hypesthesia over the lateral side of the third toe and the medial side of the fourth toe. The patient was operated on February 29th and a digital neuroma was found and removed.

As all symptoms and physical findings in interdigital neuroma are not found in every patient, it would perhaps be in order to enumerate them.

Symptoms. The symptoms are: (1) Severe, sharp, burning pain in the region of the head of the fourth metatarsal. This pain can occur on weight-bearing and on non-weight-bearing, in contradistinction to metatarsalgia which is present only on weight-bearing. It can also be felt in the toes, usually the third and fourth, but at times in the second or the fourth and fifth. (2) The patient gives the history of a desire to remove the shoe and massage the foot. (3) The patient gives the history of no relief from orthopedic shoes, metatarsal

bars, arch supports, etc. All of these symptoms were present to some degree in the patients of this group. The most constant symptoms were the sharp, lancinating pain and the desire to remove the shoe.

Physical Findings. The findings are: (1) A normal appearing transverse arch; (2) at times tenderness is found on deep pressure over the third interspace; (3) at times a palpable tumor mass in the third interspace; (4) hypesthesia over the lateral side of the third toe and the medial side of the fourth toe, and (5) x-ray examination fails to show any evidence of bony abnormality. The physical finding of the patients of this group were by no means as numerous as mentioned above; all appeared to have a normal transverse arch. One of the four proved to have tenderness in the third interspace on firm pressure but none exhibited a palpable tumor. All patients proved to have areas of hypesthesia over the lateral side of the third toe and the medial side of the fourth toe.

OPERATIVE TECHNIQUE

Both plantar and dorsal approaches have been suggested but we have found a combination of both to be more satisfactory in our hands. With the use of a Boyd-Campbell tourniquet on the thigh and the patient under sodium pentothal anesthesia, an incision is made starting on the dorsum of the foot at the base of the toes in the third interspace. This is carried through the web and on to the plantar surface for about ¾ inch. Then by blunt dissection the digital nerve is located, usually by sighting the neuroma first. The nerve is followed proximally and then distally to its terminal branches, and excised. Postoperatively the patients' courses have been uneventful and they are discharged on the fourth or fifth postoperative day. They return to the office or clinic on the tenth day for the removal of the sutures.

All patients have obtained complete relief of symptoms and have had no return of their preoperative complaints. The small plantar scar has not given any difficulty.

PATHOLOGY

On examination of the neuroma *in situ* one finds a fusiform swelling of the digital nerve just proximal to the distal bifurcation of its terminal branches. This is moderately firm to the touch and does not appear to be separable from the digital nerve itself.

The microscopic examination shows that the connection tissue about the nerve is edematous and thickened. The perineurium shows fibrotic and hyalin changes which markedly thicken the whole structure. (Figs. 3 and 4.)

The examination of the nerve fibers showed that there is a decrease in the number of fibers and that the fibers themselves are degenerative, atrophic and fibrotic.

The examination of the digital artery of the four cases disclosed only one to be thrombotic. Two others were entirely normal, while in the fourth case the artery showed degenerative changes.

CONCLUSION

Four cases of proven plantar interdigital neuroma have been presented. A review of the literature, etiology, symptoms, physical findings and surgical treatment are discussed.

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TUMORS OF THE DIAPHRAGM

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PRIMARY tumors of the diaphragm are unusual. Granché[1] reported the first one which he discovered at necropsy in 1868. Since that time almost all of them have appeared as isolated case studies. Robson and Collis[2] in 1944 reviewed the reports of twenty-one cases. In going through the literature we have found thirty apparently authentic cases. We did not include four others because they were based on clinical diagnoses only, and we consider the clinical diagnosis of a diaphragmatic neoplasm as necessarily somewhat inconclusive. Also, detailed information on one case reported by Nylander[3] in the German literature in 1942 is not available to us, so we have left it out of our summary.

Recently one of us (O. T. C.) removed a cyst of the diaphragm. There were records of three other diaphragmatic tumors in our files. Short summaries of these cases follow:

CASE REPORTS

CASE I. A thirty-nine year old white woman was symptom-free but in a chest survey a lesion was found in the right lower part of the thorax and she was referred to the Mayo Clinic with the diagnosis of a probable teratoid tumor. Physical examination gave negative results. Roentgenograms of the thorax (Fig. 1) disclosed a rounded mass in the anterior axillary line just above the diaphragm on the right, with some diaphragmatic pleuritis in the area and calcification in the wall of the tumor; it was thought that the lesion probably was an infected cyst. The preoperative diagnosis was indeterminate tumor of the right lower anterior part of the thorax. At operation a posterolateral incision was made on the right, with removal of the eighth rib. The anterior part of the diaphragm was adherent to the thoracic wall with some rather dense adhesions. A firm, smooth, ovoid mass could be felt in the diaphragm. This was dissected out and removed. It left a defect about 6 by 10 cm. in size in the anterior part of the diaphragm. This was closed with one row of interrupted and one row of continuous chromic catgut sutures. The pathologist made a diagnosis of fibrous-walled cyst containing putty-like material. (Fig. 1, inset.)

CASE II. A forty-five year old white woman died of peritonitis after a pelvic operation. She gave a history of tachycardia and dyspnea on exertion. A clinical diagnosis of chronic mitral endocarditis with mitral regurgitation and stenosis was verified at necropsy. A posteroanterior roentgenogram of the thorax made preoperatively did not reveal abnormal findings. At necropsy a lipoma 4.3 cm. in diameter was found in the left side of the diaphragm. (Fig. 2.)

CASE III. An eighty year old white woman died of cerebral vascular disease. She had generalized arteriosclerosis and diabetes mellitus. Physical examination of her thorax revealed nothing unusual, and a roentgenogram of the thorax showed only calcification of the aorta. At necropsy a lipoma 1 cm. in diameter was found in the right side of the diaphragm.

CASE IV. A fifty-eight year old white woman die of a dissecting aneurysm of the aorta while recuperating from a gastric operation. The physical examination and the roentgenograms of the thorax had revealed nothing unusual. At necropsy a lipoma 1 cm. in diameter was found in the right side of the diaphragm.

The case reports in the literature are summarized in Table 1. The pathologic diagnoses are shown in Table II which includes the cases reported by us. There were eighteen malignant and sixteen benign tumors. Our diaphragmatic cyst is the second one to be recorded, the first having been reported by Robson and Collis.[2]

Seven benign tumors of the diaphragm have been removed successfully. Five patients with malignant tumors have been operated on; three subsequently died of metastasis and two remained well.

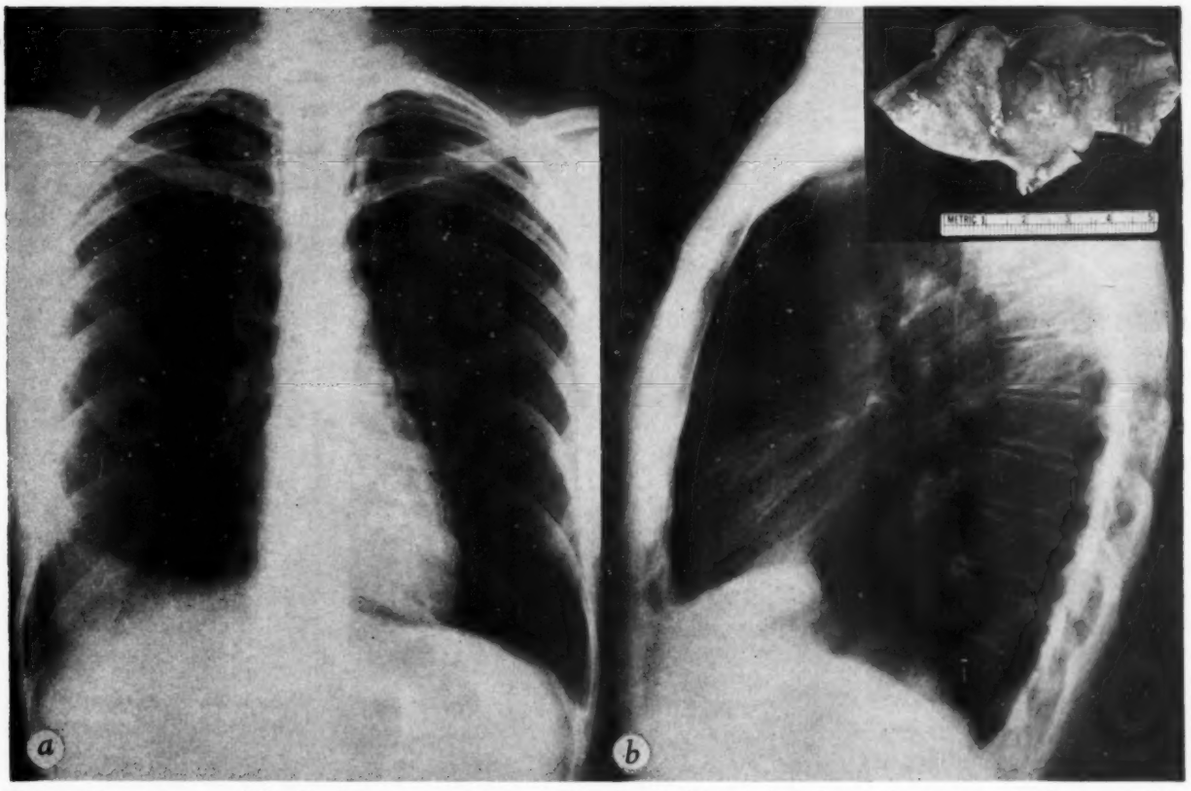

FIG. 1. Case 1, tumor of the diaphragm; *a*, anteroposterior view; *b*, lateral view. Inset, the cyst removed at operation has been opened up.

The clinical manifestations of diaphragmatic tumors were not very characteristic. However, some of the complaints recurred in most of the cases and therefore may be briefly summarized. Usually there was more or less severe pain in the lower part of the thorax, with costal extension and with accentuation on deep inspiration. Most of the patients had a cough which, in some cases, was productive of blood-streaked sputum. In several instances the tumor was palpable as a bulging through the ribs and, in a few, an upper abdominal mass that moved with respiration was noted. In these latter instances the mass was erroneously identified preoperatively or before necropsy as a pathologic condition of the liver or spleen. Frequently, the benign tumors presented no symptoms whatsoever.

It is most difficult to diagnose a diaphragmatic tumor from the usual roentgenograms of the thorax. With a large tumor a mass may be seen but its identity cannot be definitely established as separate from surrounding structures. Roentgenoscopy will reveal that its movement is synchronous with that of the diaphragm.

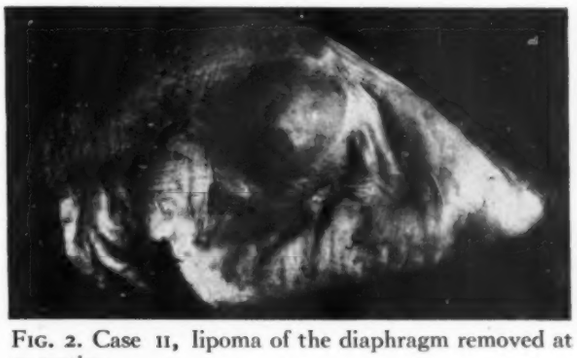

FIG. 2. Case 11, lipoma of the diaphragm removed at operation.

Artificial pneumothorax, if possible, will separate the lung from the diaphragm, and in certain instances, as described by Söderlund,[15] will allow thoracoscopic examination with visualization of the tumor. Pneumoperitoneum, as described by Binney,[31] will help separate the adjacent structures of the abdomen, and thus facilitate the diagnosis.

TABLE 1

Author, Year	Age, Sex	Side	Symptoms	Diagnosis	Remarks
Granché,[1] 1868	M	..	Not stated	Fibroma	.....
Clark,[4] 1886	65 F	R	None related to tumor	Lipoma	Incidental finding at necropsy
Alexander,[5] 1896	....	..	Not stated	Fibrosarcoma	.....
Dalzell,[6] 1887	42 F	R	Cough	Sarcoma	Necropsy; metastasis to lung
Kramer,[7] 1899	54 M	L	None related to tumor	Chondroma	Necropsy; incidental finding
Gross,[8] 1911	30 M	R	Thoracic pain on right with deep breathing; small mass under left costal margin	Fibrosarcoma	Removed surgically; death from recurrence 7 months later
Bonamy,[9] 1912	24 F	R	Swelling between 8th, 9th and 10th ribs	Multiple fibromas (4)	Diagnosed preoperatively as hydatid cyst of liver; removed surgically; recovery
Sauerbruch,[10] 1913	43 F	L	Abdominal pain; mass palpated in L. U. quadrant, moving with respiration; diagnosed splenomegaly preoperatively	Fibromyosarcoma	Removed surgically; recovery
Van Nes,[11] 1921	65 F	L	Thoracic pain on left, worse with inspiration; dyspnea; cyanosis	Fibrosarcoma	Tumor the size of a child's head found at necropsy
Burvill-Holmes and Brody,[12] 1932	50 M	R	None related to tumor	Angiofibroma	Found at necropsy; diagnosed before death by roentgenogram but patient soon died of tuberculosis
Müller,[13] 1933	45 F	R	None recorded	Myoblastic sarcoma	Discovered at necropsy
Kirshbaum,[14] 1935	47 M	R	Thoracic pain on left with deep breathing; cough; hemoptysis; weight loss	Rhabdomyosarcoma	Discovered at necropsy; multiple metastases in both lungs
Kirschbaum,[14] 1935	58 M	L	Thoracic pain; dyspnea; mass in L. U. quadrant of abdomen	Leiomyosarcoma	Discovered at necropsy; metastasis to lung
Söderlund,[15] 1937	50 F	L	Pain in left thorax worse with inspiration, extending rib	Lipoma	Surgically removed; recovery; diagnosed preoperatively with pneumothorax, pneumoperitoneum and thoracoscopy
Ballon and Spector,[16] 1939	45 F	L	None	Lipoma	Discovered at necropsy; incidental finding
Gale and Edwards,[17] 1939	54 M	R	Pain in right shoulder and right side of thorax; diagnosed diaphragmatic tumor by pneumoperitoneum	Endothelial sarcoma	Surgical removal; recovery
Kinsella,[18] 1939	62 M	R	Mass between 6th and 7th ribs in anterior axillary line; thrill and bruit over tumor	Fibromyoma	Surgical removal; recovery; large blood vessels running over the surface at site of tumor
Ryan,[19] 1939	51 F	R	Roentgenogram revealed high right diaphragm; abdominal exploration negative except for free fluid	Myosarcoma	Discovered at necropsy
Peery and Smith,[20] 1939	14 M	R	Pain with deep inspiration, dyspnea; tumor attached to ribs	Rhabdomyosarcoma	Discovered at necropsy
Petacci,[21] 1940	43 F	L	Dyspepsia initially; later, thoracic and abdominal pain	Fibromyosarcoma	Discovered at necropsy

TABLE I (*Continued*)

Author, Year	Age, Sex	Side	Symptoms	Diagnosis	Remarks
Hyman and Lederer,[22] 1941	73 F	R	Edema of legs; ascites; roentgenogram revealed some fluid in right base	Fibrosarcoma	Tumor encircled inferior vena cava, with thrombosis of that vessel; discovered at necropsy
Ackerman,[23] 1942.....	27 M	R	Pain in right lower part of thorax, productive cough, dyspnea, hemoptysis; roentgenologic diagnosis of diaphragmatic tumor with pneumothorax and pneumoperitoneum	Fibrosarcoma	Partial removal at operation; metastasis to lung; death later
Arkless,[24] 1942.....	45 M	L	Pain worse with inspiration; dyspnea, cough; pneumoperitoneum indicated subphrenic mass	Rhabdomyoma	Removed surgically; death from sarcoma of left part of thorax later so it probably was sarcoma
Soto,[25] 1943.....	14 M	L	Thoracic pain; hemothorax	Lipoma	Surgically removed; recovery
Soto,[26] 1944.....	14 M	L	.....	Lipoma	Removed surgically; recovery
Robson and Collis,[2] 1944	22 M	R	Pain in right side of thorax worse with inspiration; roentgenogram revealed oval shadow in right lower part of thorax	Cyst	Surgically removed; recovery
Rosenthal and Frissell,[27] 1945	80 F	R	None	Benign mesothelioma	Incidental finding at necropsy
Klassen, Patton and Bemen,[28] 1945	42 M	R	Presenting symptom was osteo-arthropathy; dry cough; roentgenogram revealed right lower part of thorax obliterated	Neurofibroma	Surgically removed; recovery
VanAlstyne,[29] 1945....	7 da. F	R	Born with grunting respirations; roentgenogram revealed triangular shadow adjacent to right diaphragm	Hemangio-endothelioma	Discovered at necropsy; tumor surrounded great vessels inferiorly
Branwood and Glazebrook,[30] 1946	42 M	R	Pain in right upper quadrant of abdomen; cough, hemoptysis	Mixed-cell sarcoma	Metastases to ribs, lung, aorta; discovered at necropsy

Along with tumors of the diaphragm, it is impossible to diagnose accurately a fairly high percentage of all intrathoracic lesions preoperatively even with all the clinical aids one can enlist. Today exploratory thoracotomy carries a mortality rate of less than 1 per cent in the hands of well trained surgeons. Thus, we believe that every patient who has a tentative diagnosis of a primary tumor of the diaphragm should be operated on provided his general condition is satisfactory.

SUMMARY

Four cases of diaphragmatic tumor have been reported herein. In addition, reports of thirty apparently authentic cases were

TABLE II

PATHOLOGIC DIAGNOSIS IN THIRTY CASES OF DIAPHRAGMATIC TUMOR

	No.
Lipoma	8
Fibrosarcoma	5
Rhabdomyosarcoma	3
Fibromyosarcoma	2
Fibroma	2
Cyst	2
Mixed-cell sarcoma	1
Mesothelioma	1
Neurofibroma	1
Fibromyoma	1
Chondroma	1
Angiofibroma	1
Sarcoma	1
Myoblastic sarcoma	1
Leiomyosarcoma	1
Myosarcoma	1
Endothelial sarcoma	1
Hemangio-endothelioma	1

found in the literature. The clinical manifestations of such tumors were not very characteristic. Usually, more or less severe pain occurred in the lower part of the thorax, with costal extension and with accentuation on deep inspiration. Most patients had a cough and, in some instances, blood-streaked sputum was produced. In several cases the tumor was palpable as a bulging through the ribs; in a few, a mass that moved with respiration was noted in the upper part of the abdomen. The benign tumors often produced no symptoms whatever. Roentgenologic examination aided in establishing the diagnosis in some instances. Thoracoscopic examination, after artificial pneumothorax, sometimes was helpful. Also, in some cases pneumoperitoneum was an aid in establishing the diagnosis.

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CARCINOMA OF THE COLON IN CHILDREN*

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THE occurrence of carcinoma in the colon of a child has stimulated interest in this condition. It occurs with greater frequency than one is apt to think and a survey of the recent literature reveals an increasing number of cases reported. Cancer in childhood is an important health problem. It causes more deaths than pertussis, poliomyelitis, syphilis, measles and scarlet fever put together. As a cause of death it holds sixth place from the ages of ten to fourteen years.

The most common sites of carcinoma in children according to Daregon[1] are the bones, kidneys, eye and orbit, lymphatics and blood-forming organs, the soft somatic tissues and the nervous system. Carcinoma of the digestive tract, the most important cause of death from cancer in adults, is so rare in children that those afflicted with it are considered to be curiosities.

Coller and Berry[2] point out that pain or abdominal distress arising from carcinoma of the right side of the colon is often ill-defined and poorly localized. The symptoms of vague indigestion may resemble those of chronic disease of the gallbladder or recurring attacks of appendicitis. In regard to prognosis the authors state that as in cancers of other parts of the body, the younger the patient is the more rapidly the lesion tends to grow and the earlier it metastasizes. The frequent failure to diagnose preoperatively the nature of the disease indicates the lack of awareness generally of this clinical entity. Many cases had surgical intervention with the preoperative diagnosis of tuberculous peritonitis.

Bonelli[3] states that cancer of the colon and rectum ranks first among the digestive tract malignancies in children. In an excellent survey of the literature he found a total of 142 cases reported. He states that males predominated more than two to one, with seventy-one males and thirty-two females in the series. The largest percentage of lesions, 73.8 per cent, was found in the descending colon and rectum.

Cancer of the colon in children has been reported in practically every year of life, with greater frequency in the second decade. Laird[4] emphasizes the fact that while rectal bleeding is a common symptom in adult malignancies of the colon, children have abdominal pain as a more common symptom. Vomiting and constipation are the other more common signs. He states that one case has been reported in a newborn monster and one in a three year old child.

Webster[5] in Australia reported a case occurring in the sigmoid colon of a nine year old girl. This patient had symptoms for two months prior to entry into a hospital. Her symptoms were intermittent abdominal pain and diarrhea with blood and mucus in the stool. Physical examination disclosed a smooth, round, tender, nonmobile mass situated in the midline in the hypogastrium. At surgery it was found that the lesion had replaced the normal mucosa for 10 cm. and caused a narrowing of the lumen. The patient had a resection and colostomy and later this was closed. She was well for over three years and then died suddenly. Metastasis was found in the right lobe of the cerebellum.

The near hopelessness of many of these cases has been pointed out. The delay and frequent misdiagnosis of these lesions may account partially for the low recovery rate.

Warthen,[6] in reporting a case in a fourteen year old, colored female, stated that the patient had colicky upper abdominal pain and constipation. His patient had an abdominal mass, a finding not frequently

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noted in many of the cases except when the right colon is involved. She was diagnosed preoperatively as having tuberculous peritonitis. At surgery metastatic nodes were seen involving the omentum. The extensiveness of the carcinoma when found at surgery accounts in part for the serious prognosis.

In 1938 McGuire[7] reported a case of adenocarcinoma of the colon in a boy of fifteen years; the lesion was located in the transverse colon as was shown by roentgen examination. At surgery this lesion was found to be annular; it partially obstructed the colon and extended to and involved the greater curvature of the stomach. A fistula had formed between the process in the colon and the process in the stomach. Unfortunately this patient had very few symptoms. He complained of pain, dull in character and transient. There was no diarrhea or constipation, no jaundice and no tarry or bloody stools. The pain was in the upper abdomen and was noted only when certain movements of the body occurred. Despite these meager symptoms the lesion had already made marked progress.

Pennell and Martin[8] state that a careful search of the smaller lymphatic nodes should be made. Often the larger lymphatics are free from metastases but the smaller ones, scarcely as large as peas, may be the seat of carcinoma deposits. In their study the authors found only very few cases with duration of more than seven months and they believe that prognosis of carcinoma of the colon is nearly hopeless. However, in 1946 Scholefield[9] reported a case in which the patient had been followed for seven years and was well at that time.

While the etiology of cancer of the colon is unknown, polyps, inflammatory lesions and adenomas are considered to be precancerous. Polyps may be single, multiple or diffuse. Bonelli[3] expresses the opinion that ulcerative colitis, in which constant destruction and repair occur, may result in carcinoma not infrequently in the young when the repair stage of the disease runs rampant. The two conditions, polyposis and ulcerative colitis, occur more often in the younger age groups.

Among other proposals for cancer control in childhood, Daregon[1] suggests investigation and even repeated investigations in the presence of an atypical symptom complex, namely, an unusual child patient, especially the precocious or retarded child, if the departure from the normal has been increasingly apparent or if the child has periodic, vague illnesses with phases of normal health between attacks. Daregon also suggests that routine semi-annual physical examinations should be made after the age of six years.

Much improvement can be made in earlier recognition of colon malignancies by use of more frequent x-ray films and fluoroscopy. Particularly, barium and air contrast studied will be of value in locating the lesion. In the lower colon, digital examination, sigmoidoscopy and proctoscopy are of greatest value.

CASE REPORT

J. M., a male, aged fourteen, first started to complain in October, 1947, of a recurring, dull, colicky pain in the right side of his abdomen. His attending physician watched him for two or three weeks but the pain increased in intensity and became rather severe; it localized in the right side of his abdomen. He was operated upon by his attending physician and his appendix was removed through a McBurney incision. After he left the hospital about the fifth day his symptoms returned with even greater intensity and his abdomen became greatly distended. A second operation was performed by the same surgeon, this time through a right perimedian incision. A tumor mass was found obstructing the ascending colon and a cecostomy was performed. Relatives were informed of the seriousness of his condition. He was then transferred to another hospital under the care of one of us (R. M. B.). X-ray studies were made and a lesion in the right colon was found. It was decided that further surgery should be attempted as his cecostomy was not functioning properly. On December 15, 1947, a third operation, a palliative right hemicolectomy, was carried out as there were rather extensive node metastases.

The patient had an uneventful postoperative recovery. He regained his strength rapidly and was able to return to school. However, on January 18, 1948, he began to lose his appetite, complained of epigastric distress and later developed nausea and vomiting with rapid loss of weight. During the last week of his life severe jaundice developed and he died on February 8, 1948.

At autopsy extensive metastasis to the liver was found which was not present at the time of surgery. The jejunum was obstructed by large metastatic nodes in the mesentery. There were multiple peritoneal transplants.

The pathologic report* of the specimen removed at surgery, December 15, 1947, was as follows: Gross, the specimen consisted of the distal 2.5 inches of the terminal ileum, cecum, ascending colon and over half of the transverse colon. At the junction of the cecum and the ascending colon there was an annual constricting mass approximately 8 cm. in diameter and 2.5 cm. in thickness. This large constricting mass had completely occluded the lumen of the large bowel. In addition it was completely extended through the bowel wall to the serosal surface where it produced multiple small nodular implants which were very pale in color. Microscopically, sections through the wall of the large bowel revealed a replacement of the normal architecture by fairly dense fibrous stroma containing numerous irregular branching glandular structures of variable size. The lining epithelium of these glands showed considerable pleomorphism. In some areas it was of a tall, columnar type; the cells were dark staining, closely packed together and the nuclei had lost their polarity. In other areas, particularly in the smaller glands, the lining epithelium was a cuboidal type with rather pale eosinophilic cytoplasm and a rather dark round nucleus. Most of the sections, however, showed a very marked degree of mucoid degeneration characterized by irregular spaces separated by a network of fibrous stroma in which there were accumulations of a very pale staining basophilic debris. The diagnosis was adenocarcinoma of the colon showing a mixed pattern with extensive mucoid degeneration.

*The pathologic studies were made by Dr. Jesse L. Carr of the Franklin Hospital, San Francisco, Calif.

CONCLUSIONS

1. Carcinoma of the colon in children is an infrequent entity but should be kept in mind as a diagnostic possibility in cases of persistent colicky pain, constipation, weakness and possibly abdominal mass.

2. Much of the delay which renders metastases possible and prognosis poor may be alleviated by more thorough proctoscopic and roentgen ray studies.

3. In the event of an acute condition of the abdomen which demands surgery, and no disorder is seen in the appendix, further exploration of the bowel is indicated.

4. Use of supportive treatment, sulfanilamide and streptomycin pre- and postoperatively, reduces the hazard of surgical procedure.

5. Use of barium enema is indicated in diagnosis of abdominal pathologic condition in children.

6. Another case has been added to the literature.

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SPONTANEOUS RUPTURE OF THE UTERUS*

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SPONTANEOUS rupture of the pregnant uterus without apparent cause is a rare accident in obstetrics. The literature contains a small number of cases in which rupture had occurred during pregnancy or shortly after the onset of labor and in which no causative factor could be found, i.e., no uterine anomalies, uterine scar from previous sections, faulty presentation or prolonged labor.

We present the clinical findings of a primigravida with spontaneous rupture of the uterus at term followed by a repeated rupture four years later at seven months' gestation.

CASE REPORT

A twenty-one year old white primigravida, at term, was admitted to Lake View Hospital on July 2, 1942, complaining of low back pain, pressure on her rectum and a slight amount of vaginal bleeding. She had started having mild labor pains two hours prior to admission.

Her last menstrual period occurred October 6, 1941, and the expected date of delivery was July 12, 1942. Her prenatal course was uneventful and pelvic measurements were adequate.

On physical examination the patient appeared uncomfortable, pale but she was not in severe pain or shock. Her blood pressure was 100/80. She complained of pressure against her rectum and pain in her abdomen. She preferred to lie on her right side stating that she was more comfortable in that position. The abdomen felt hard and tenderness was present on palpation of the uterus. The position of the baby could not be determined; no fetal heart tones could be heard. There was a slight amount of bleeding from the vagina. Rectal examination revealed a soft, presenting part slightly above the spines. No cervical dilatation was present.

Laboratory data were as follows: The Kahn test was negative. The urine revealed a specific gravity of 1.022, a trace of albumin and no sugar. Her hemoglobin was 53 per cent (Sahli); the erythrocytes numbered 2,800,000; leukocytes 10,200 per cu. mm. The differential count was polymorphonuclears 82 per cent, lymphocytes 18 per cent.

An x-ray film of the abdomen in the anteroposterior position revealed a full term fetus in the breech position. The spine was bent at an acute angle with the head. In the lateral view the baby's back was found to lie toward the anterior side of the mother's abdomen. There was slight overlapping of the sutures of the skull. The limp appearance of the fetus and overlapping of the sutures were suggestive of a dead fetus. (Figs. 1 and 2.)

A diagnosis of premature separation of the placenta with a dead fetus was made. The patient was given a blood transfusion of 500 cc. and it was deemed best to deliver her by section. Operation was performed twelve hours following her admission to the hospital. Under general anesthesia and through a midline incision the abdomen was opened. An empty flattened uterus containing a complete, longitudinal, 16 cm. in length tear, through its posterior wall was present. This tear extended from the fundus to the internal os (full length of the corpus). A full term, dead male infant was found lying behind the uterus. The pelvis contained several blood clots and about 300 cc. of blood. Since this patient was a young primigravida and was desirous of having another pregnancy, the edges of the tear were dèbrided and approximated with three layers of No. 1 chromic sutures. The patient had an uneventful postoperative course and was discharged from the hospital on her twelfth day. She was examined two weeks later and appeared in good health.

The patient was again examined four years later (August, 1946) in her third month of pregnancy. Her prenatal course continued uneventfully until the morning of December 12, 1946, when she was again admitted to the hospital complaining of severe abdominal pain

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1 2

FIG. 1. Anteroposterior view showing breach presentation and collapse of the fetal spine.
FIG. 2. Lateral view showing slight overlapping of the skull bones. In the original film under a strong light the faint outline of the collapsed uterus can be seen anterior to the fetus.

and in shock. The blood pressure was 70/50, pulse 120 weak and thready. There was marked tenderness and rigidity of the abdominal wall together with a moderate amount of vaginal bleeding. The fetal parts could not be palpated and fetal heart tones were absent. Because of the previous history of a ruptured uterus, immediate operation was decided upon. Under general anesthesia the former abdominal scar was excised and the abdomen was opened. The posterior wall of the uterus contained a complete tear located at the previous identical site. A seven month dead male fetus in an intact amniotic sac was found behind the empty uterus. The placenta protruded through the uterine tear. A supracervical hysterectomy was performed and two blood transfusions were given. The patient made an uneventful recovery and was discharged from the hospital on her twelfth postoperative day. The uterus measured 32 by 20 by 12 cm. The tear measured 15 cm. in length and involved the entire thickness of the posterior wall. (Fig. 3.)

COMMENT

Data concerning the time and etiology of the rupture create the most interest. Undoubtedly, the tear occurred soon after the onset of labor pains prior to admission to the hospital and no apparent cause for the rupture during her first pregnancy could be found. The patient showed little evidence of shock and was operated upon with the tentative diagnosis of a premature separation of the placenta. The usual treatment for rupture of the uterus is immediate hysterectomy. If the rupture takes place during the first pregnancy with the loss of the baby and the patient is desirous of having a child, the tear in the uterus may be sutured. This preserves the uterus for future pregnancy and also for a possible future rupture. Suture should be restricted to uteri in which the torn edges are not too irregular or badly traumatized and in which sepsis is not present.

In a series of fifty-three cases reported by Delfs and Eastman[1] one of the seventeen spontaneous ruptures occurred without provocation in a thirty-four year old para v whose uterus ruptured at term before the onset of labor and there was nothing in the

FIG. 3. Gross specimen of the uterus showing the complete rupture.

past or present history to explain the accident.

Bill, Barney and Melody[2] reported two spontaneous ruptures of undetermined etiology in their series of twenty-three cases. One patient was a twenty-two year old para III who died immediately after spontaneous delivery of a seven month stillborn. Autopsy revealed a complete tear. The second patient, a thirty-four year old para IV, had an easy labor and low forceps delivery, but suddenly went into shock and expired during laparotomy. Operation revealed an incomplete tear in the lower uterine segment, 6 cm. in length, located below the bladder flap. The authors are inclined to the belief that perhaps an old cervical laceration might have given way during labor with extension of the tear into the lower uterine segment. Both of these patients had easy labors and both had uncomplicated deliveries.

Lynch[3] mentions a spontaneous rupture of the uterus in an early pregnancy which the pathologist reported as being due to an overactive nidation of the ovum with excessive autolysis of the maternal tissues from the trophoblastic elements. This succession of events may be an etiologic factor in some of these obscure cases.

CONCLUSIONS

1. No apparent etiologic factor can be found in a small number of ruptured uteri occurring during pregnancy.

2. Rupture of the uterus may occur without much evidence of shock, and the condition may be erroneously diagnosed as premature separation of the placenta.

3. The treatment of choice in a case of ruptured uterus of unknown etiology is hysterectomy since preserving the uterus may predispose to a repeated rupture.

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INTUSSUSCEPTION IN AN ADULT*

PRIMARY RESECTION WITH RECOVERY AND SUBSEQUENT NORMAL PREGNANCY

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INTUSSUSCEPTION in adults is so uncommon that diagnosis is often either unsuspected or, if considered, abandoned for the most common causes of abdominal symptoms. To date there have been reported approximately 600 cases in the world literature. These have been collected and reported chiefly by Eliot and Corscaden,[1] Christopher[2] and Nichols.[3] Undoubtedly, there have been many more recognized but not reported. Likewise, there have probably been others terminating fatally but attributed to other causes which were not confirmed by exploration or autopsy.

Thus far no clear and definite clinical picture of this condition has been described. Eliot and Corscaden[1] made the first most satisfactory attempt. Black,[4] in a recent report of a case, presented a brief but comprehensive review of the whole subject.

The main object in presenting another case report is an attempt to clarify the clinical picture and perhaps thereby aid in identifying more cases than are now presumed to prevail.

CASE REPORT

The patient was a married white woman, twenty-six years of age. She had always enjoyed average health and never had any abdominal operations. In February, 1944, she contracted an acute upper infection for which one of the sulfonamide drugs was prescribed by her local physician. Recovery was complete except for a slight cough and general weakness.

A short time after this episode she experienced, for the first time in her life, epigastric distress characterized by slight colicky pains gradually increasing in intensity, reaching a maximum in a few minutes and then spontaneously subsiding. These attacks occurred chiefly in the forenoon, seldom in the afternoon or evening and were not related to food intake. There were no accompanying nausea, vomiting, constipation or diarrhea.

After several weeks the attacks subsided sufficiently for her to resume her duties as a school teacher.

No significant changes occurred until the latter part of April, 1944. One evening she was suddenly seized with severe colicky pains in the epigastrium accompanied with nausea and vomiting. The vomitus contained food eaten earlier in the day but no blood. There had been no constipation. The patient attributed the attack to eating ice cream but this had not previously caused similar symptoms. After a few hours the attack subsided spontaneously. She restricted herself to a milk diet with no immediate recurrence of symptoms.

On April 25, 1944, she presented herself for a general examination. Further history was insignificant. The general physical examination was entirely negative. Routine urine and blood studies were negative except for a slight secondary anemia. X-ray examination of the gastrointestinal tract including cholecystograms was well within normal limits. She was advised to continue with a soft diet, frequent small feedings and iron therapy for the slight anemia. No further attacks seemed imminent.

However, on April 27th she was admitted to the hospital with excruciating, colicky pains throughout the abdomen accompanied with occasional slight emesis. The vomitus contained no blood. Prior to the attack the patient had had a normal stool containing no blood and not accompanied with any unusual symptoms. The physical examination was again negative except for slight tenderness throughout the abdomen. No one area was more tender than any other. Muscle spasm was absent and no masses were palpable.

* From the Department of Surgery, Lockwood General Hospital, Petoskey, Mich.

The following day, April 28th, there were paroxysmal recurrence of the generalized, colicky pains in the abdomen with occasional slight vomiting without blood. Enemas gave relief with return of small particles of normal stool. The abdomen remained negative to physical examination until late in the evening. Then a large, irregular, lobulated and slightly tender mass developed in the left abdomen. It was quite high in the upper left quadrant, descended freely on deep inspiration and very strongly resembled an enlarged spleen. The patient seemed surprisingly comfortable and not particularly annoyed by abdominal examinations.

On April 29th there were no striking changes. Small amounts of clear, greenish fluid were raised but appeared to be more by regurgitation than actual vomiting. The mass in the abdomen was smaller, presented lower in the abdomen being to the left and just below the level of the umbilicus, lobulated, freely movable and only slightly tender. Muscle spasm and rigidity were absent. Blood and urine studies remained within normal limits. Small stools contained no blood. The temperature never exceeded 100.3°F. Treatment consisted of parenteral administration of fluids and sedation.

The patient continued to be quite comfortable until late in the afternoon of April 30th. Suddenly the abdominal pains recurred accompanied with emesis of dark colored fluid but without fecal odor. The stools became bloody. The abdominal mass increased in size but was no more tender than formerly and there were no muscle spasm or rigidity suggesting peritonitis. After the usual period of time the pains did not subside. Intussusception was then suspected as the cause of the obstruction but admittedly with only slight conviction. Operation was deemed advisable.

Under spinal anesthesia (procaine hydrochloride—150 mg.) with light ether supplement, abdominal exploration was undertaken by one of us (W. H. P.). An extensive intussusception of the small bowel into itself was found. The intussuscepted portion was approximately 20 cm. in length. The proximal end of the bowel appeared to be normal except for distention. No gross evidence of peritonitis was found. Inasmuch as the intussusception could not be reduced, a radical resection and side-to-side anastamosis were done.

The microscopic pathologic report on the specimen was as follows: "Intussusception of the small intestine with infarction, gangrene and localized fibrinopurulent peritonitis. This intussusception has been occasioned by a large leiomyoma of the intestinal wall which projected into the lumen. This is a non-malignant neoplasm and the prognosis should be good except for the hazards inherent in the intussusception and the operation."

The postoperative convalescence was entirely uneventful. She was discharged from the hospital on May 24th, the twenty-fourth day after operation.

In August, 1944, approximately three months after operation the patient became pregnant for the first time. The entire prenatal course was normal. On May 28, 1945, practically a year to the day from her discharge from the hospital following the operation, she delivered a full term, normal baby. The delivery and postpartum course were without incident.

COMMENT

Although reports vary, it is generally conceded that approximately 60 per cent of intussusceptions are caused by tumors and these are more likely to be benign than malignant. This case is an example.

The causative agent in this case, leiomyoma of the small intestine, had undoubtedly been present for a long time but there was no evidence in the history, physical or laboratory findings to suspect it. During the period from February until April the principal symptoms were recurrent and there were colicky pains in the abdomen with vomiting, the latter being of minor importance. These signs and symptoms were not definite enough to make a positive diagnosis. Later when actual intestinal obstruction developed with the presence of a mass and melena, the causative agent was unlikely to be one of the more common ones. However, at this time operation is imperative and particularly urgent in intussusception because this is a strangulating type of obstruction and the amount of bowel involved rapidly increases. In all similar, obscure abdominal conditions, even in the absence of a mass and melena, intussusception should be suspected.

The subsequent pregnancy was quite incidental and irrelevant. But it is interesting to note that pregnancy did occur and that the intussusception with the operation did not interfere with the normal course of it.

CONCLUSIONS

The signs and symptoms of intussusception in adults are indefinite and confusing. Even after obstruction has obtained the diagnosis is suspected only after eliminating the more common causes of obstruction. There is no definite clinical picture unless a rather negative type of hypothesis is assumed, namely, if an abdominal condition is not otherwise explained, it could be intussusception. The important point is to suspect intussusception and to operate at the time when a minimal amount of bowel is involved.

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Hiatus hernias are most easily repaired through the supra-diaphragmatic approach. The left eighth rib is excised and a rib spreader inserted. The sac is easily identified. It is freed from its surroundings and its contents emptied. Unless the sac is very long, it need not be excised; but its mouth or opening must be closed tightly. Interrupted silk sutures are suitable; fascial sutures may also be used. When properly repaired the new hiatus will lodge the esophagus without constricting it and will permit the surgeon to pass his finger alongside it easily, down to the abdominal surface of the diaphragm. (*Richard A. Leonardo, M.D.*)

PLACENTA ACCRETA IN SYPHILIS

WILLIAM VERNON WAX, M.D.

Catskill, New York

IN a search of the literature only 118 authentic cases of placenta accreta have been reported according to Meyer and Ashworth's tabulation in 1940.[5] In 1941 Anderson[1] reported a case. No case of placenta accreta associated with syphilis has been reported in these cases. Lawson and Oginz[4] reported that John Osborne Polak of the Long Island College Hospital in Brooklyn, New York, in his thirty-four years of experience encountered only one case of placenta accreta in 6,000. Hirst found this anomaly only once in 40,000 deliveries.

Placenta accreta produces a partial or complete absence of the decidua pasalis allowing the villi to burrow directly into the uterine musculature which in turn causes the placenta to be retained in the uterine cavity. A condition producing primary atrophy of the endometrium may be the factor in producing placenta accreta. The retained placenta may be of two kinds, namely, adherent or non-adherent. The non-adherent retained type is quite common, the placenta having separated but not being expelled. A retained adherent placenta is rare but in some instances of excessive proliferation of chorionic villi the placental tissue may invade the muscular structure sometimes even penetrating the uterine wall. This is known as a true placenta accreta. If an effort is made to separate this type of placenta, the uterus may be ruptured with its dire consequences or the patient may die of hemorrhage. The only safe and practical procedure is uterine extirpation.

Factors which are reported in the literature[6] and believed to be of prime importance in producing placenta accreta are: previous cesarean section, too thorough curettage, endometritis, submucous myomas and possible dyshormonism. Any condition producing primary atrophy of the endometrium might be a factor in the causation of an accreta. The chief symptom is more or less brisk bleeding when delivery of the placenta is attempted. The diagnosis is made after an attempt at manual removal has failed to establish a cleavage plane between the placenta and the uterine musculature, thereby showing retention of the placenta within the uterine cavity as differentiated from the simple retained placenta. As mentioned heretofore, immediate hysterectomy is imperative as soon as the diagnosis is made. Although several authors reported waiting for varying intervals in the presence of shock, infection[5] and absence of hemorrhage,[5] syphilis as a complication is no contraindication to operation.

Normally the placenta is a round disc-like organ weighing about one-sixth of the weight of the infant or from 1 to ½ pound. The weight varies with the size of the child but may be influenced by various diseases. It measures from 15 to 20 cm., in diameter and is ½ to 3 cm. in thickness. One of the most notable instances of increase in weight of the placenta is found in syphilis.[9] Diffuse infiltrations with wandering cells, vascular changes both in the placenta and umbilical cord distinguished as elsewhere by the thickening of the adventitia and intima and curious modification of the villi consisting of new formation of loose connective tissue about the central blood vessels such as to cause a great bulbous swelling of each villus are found. Hence, there is a marked enlargement of the placenta because of the striking disproportion between the size of the uterus and

* From the Memorial Hospital of Greene County, Catskill, N. Y.

the placenta. (Fig. 1.) In placenta accreta one sees microscopic irregular infiltration of syncytium and Langhans' cells in degenerated muscle. This anomoly is due to primary atrophy of the endometrium, the decidua basalis being absent.[2]

According to Meyer and Ashworth the mortality for manual removal or curettement is 58 per cent, for partial manual removal and vaginal hysterectomy 36.4 per cent, for partial manual removal and supravaginal hysterectomy 18.9 per cent, and no deaths for supravaginal hysterectomy without attempt at manual removal.

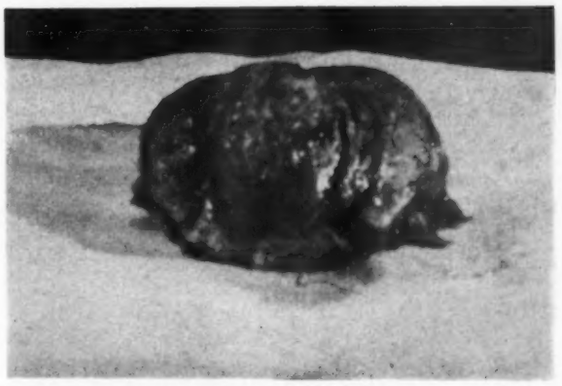

FIG. 1. The fundal portion of the placenta is tightly adherent to the myometrium, extends into it and shows no clear line of demarcation.

CASE REPORT

The following case is presented not only because of the placenta accreta and accompanying syphilis but because the case varied from the usually reported management of this anomoly:

Mrs. M. B. age forty, a white female, was admitted to the Greene County Memorial Hospital, Catskill, New York, on October 1, 1946, at 4:10 P.M. the patient stated that she was about seven months' pregnant. Two weeks prior to admission she complained of a slight bloody vaginal discharge. About a week prior to hospitalization the flow increased and she had moderate pain in the lower abdomen. She was seen by her family physician and put to bed. The following day her membranes ruptured. She had no pains on that day but on September 29, 1946, she began regular labor pains and passed a stillborn, macerated fetus of about seven months. Her physician was called and found that she had passed some clots but no placenta. A small portion of cord protruded. It was found impossible to deliver the placenta by usual means. Her flow was then moderate until she was admitted to the hospital.

Her past history showed that she had been treated for active secondary syphilis within the past year. (Table 1.) She had been given 1,200,000 units of penicillin under the supervision of the State Department of Health at Albany Hospital and discharged January 23, 1946.

Five years before she had an ectopic pregnancy followed by a right salpingo-oophorectomy. She has five children living and well, the youngest five years of age. She had one miscarriage about nineteen years before.

On admission she appeared to be a well developed, well nourished white adult female forty years of age. Her pulse was 92, respiration 20, temperature 99.8°F., blood pressure 110/68; mental orientation was good, mental status clear. Her skin was clear with no rash. No gross deformities were noted. Examination of the abdomen showed a firm and slightly tender uterus about the size of a six months' pregnancy. The liver edge and spleen edge were not palpable. On vaginal examination the external os was about 2 cm. in diameter, soft and spongy with no tissue or cord protruding. A foul, profuse, bloody vaginal discharge was present. There were no other gross abnormal findings. The urine showed a few white blood cell clumps (regarded as 2 plus) and was otherwise negative. The Wassermann test was 10 plus, white blood cells 12,100 red blood cell 3,830,000, hemoglobin 70 per cent, polymorphonuclear, bands 40 per cent segmented 32 per cent, monocytes 1 per cent and lymphocytes 2 per cent. The previous Wassermann and point titration tests were as follows:

TABLE 1

Date	End Point Titer
1/18/46	10+
3/16/46	26
4/19/46	9
5/29/46	7
7/25/46	31
9/2/46	78
11/1/46	57

Consultation confirmed our diagnosis of true placenta accreta and hysterectomy was

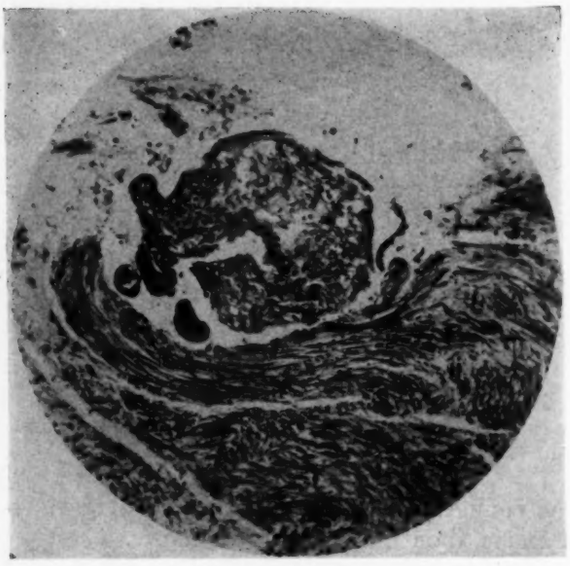

FIG. 2. The myometrium is edematous and diffusely infiltrated by leukocytes of all varieties, lymphocytes and plasma cells predominating. Beneath the site of placental implantation, numerous masses of syncytial cells have invaded the uterine musculature.

decided upon. She had been given 40,000 units of penicillin every three hours since admission to the hospital. On October 5, 1946, a supravaginal hysterectomy was performed by the author. Sulfanilamide, about 4 Gm. was placed in the pelvic peritoneal cavity. The wound was closed without drainage. She made an uneventful recovery; the wound healed *per primum*. She was discharged from the hospital on the tenth postoperative day; 40,000 units of penicillin every three hours was continued until the ninth postoperative day.

On section (Lab. No. S-46-5772) the specimen consisted of a segment of uterus without cervix or adnexa that was previously opened. (Fig. 1.) Adjacent to the endometrium the endometrial cavity contained a segment of packed placental tissue measuring 7 cm. in its greatest dimension. The uterus measured 11 by 9 by 5.5 cm. The placenta was covered on one surface by a rather thin, gray-green membrane and on section was not remarkable. The attachment to the endometrial cavity at one portion showed normal demarcation from the myometrium by a thin layer of decidua and endometrium but in the posterior part of the wall in the fundal portion the placenta was tightly adherent to the myometrium and appeared to extend into it and to be rather poorly demarcated from it. The adjacent portion of myometrium was very vascular and soft. Sections of the myometrium elsewhere showed it to be free of gross nodules.

Sections of the placenta showed chorionic villi that varied in size and shape but the majority were small. Many of the villi contained large fibroblasts with abundant eosinophilic cytoplasm. The vessels of the villi were not remarkable microscopically. The intervillous spaces were normal in size and shape.

The decidua exhibited irregularity in size and development. Some sections showed areas of well developed decidual layers but for the most part these were absent. Mostly the chorionic villi were separated from the myometrium by only a thin layer of cells that had undergone considerable degeneration and presented only nuclear remains and much eosinophilic débris. Occasional sections were noted in which this division was absent and the small villi lay in direct contact with the myometrium. The decidua was heavily infiltrated with leukocytic exudate throughout, with lymphocytes and plasma cells predominating.

Sections of the endometrium adjacent to the site of placental attachment showed only scattered areas of attempts at decidual formation and were very thin. The stroma was heavily infiltrated throughout by lymphocytes and plasma cells. The glandular elements were widely scattered and showed extensive degeneration.

The myometrium was edematous and diffusely infiltrated by leukocytes of all varieties, lymphocytes and plasma cells predominating. Beneath the site of placental implantation numerous masses of syncytial cells invaded the uterine musculature. (Fig. 2.)

Diagnosis was placenta accreta focal acute myometritis and chronic, atrophic endometritis.

The pathologic findings* in this case indicated a diagnosis of so-called placenta accreta. The uterus showed an imperfect decidua formation and, it is assumed, this was the result of a preceding endometritis. It was of course, impossible to exclude on the basis of this study the possibility of hormone imbalance. There was certainly a failure of the endometrium to respond in the normal manner to hormonal influences preceding pregnancy or menstruation. Because of the inadequate development of decidua chorionic villi penetrated the myometrium to an unusual extent and a line of cleavage between placenta and

* Dr. J. J. Clemmer supplied the laboratory report.

uterus was not readily formed during the third stage of labor.

SUMMARY AND CONCLUSIONS

1. Only 118 authentic cases of placenta accreta have been reported in the literature up to 1941.

2. No case of placenta accreta associated with syphilis has been reported to date.

3. Syphilis is not necessarily associated with placenta accreta.

4. Removal of the uterus is the only form of treatment for placenta accreta even in the presence of syphilis or other infection.

5. Penicillin is of unquestionable value prior to and following operation especially in the presence of syphilis or acute infection.

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The Early Art of Surgery

FROM PAPYRI TO MANUSCRIPTS

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THE earliest efforts of the human race to record its thoughts and history for posterity were accomplished by scratching with some hard instrument on stone or bone. It is a quality of humans to be constantly alert in the quest for improvement. That is why the Assyrians developed the idea of scratching, or rather tracing, pictures and patterns on clay tablets, then baking them. The earliest known description of infantile paralysis exists in one of these Assyrian baked tablets, about 4,000 years old, and ingenious indeed is the crutch devised to hold the withered leg.

Because it was difficult to trace a curve on stone and easier to do a straight line, all early inscriptions tend to be straight, acute or obtuse angles. This was a handicap and a challenge. Almost anywhere and everywhere, particularly along river banks, a common reed grew with an inner lining which could be cut into strips substantially wide and long. A single layer was too fragile to take ink but when another layer was laid on crosswise and then the two pressed together by soaking the whole in water and letting it dry, the resulting product served its purpose well. We have discussed in previous chapters the three most important papyri of surgical interest, the Ebers, the Smith and the Hearst. As the years went by and the papyrus dried out, it crumbled like dried leaves and it is indeed a wonder that such papyri as the aforementioned have survived to our day, particularly in the fine state of the Ebers.

It was only natural that a more adaptable and satisfactory material should be found. The skin of animals, particularly the inner lining layer, could be prepared in such manner that it would take any kind of pen or stylus stroke. The skin of the sheep and the young calf with its finer qualities was called vellum. Because the costs of production were very high, only the very finest or most important of documents could be recorded on such materials. Fortunately for the world we have access to a moderately large number of manuscripts so that instead of three, as in the case of the papyri, we have many to choose from even in the sharply limited field of those pertinent to surgical art.

Costs of getting together and binding a manuscript in those early days were so prohibitive that only the very wealthy could indulge themselves in the task. Otherwise an "angel" had to be found who would subsidize the costs. An occasional wealthy family, looking for a royal favor in the form of a higher title or a desirous land grant, would pay the costs and then present the bound manuscript as a gift to the king on his birthday or some suitable occasion. An occasional individual of great wealth, wishing to justify his place in the social scheme or aspiring to pose either as of the intelligentsia or a patron of arts and letters, would pay a stiff price for the original material, a stiffer price for the binding and putting together of the material, have the text extravagantly illuminated and illustrated, then simply run wild adorning the binding with handwrought silver, gold, silks, brocades and inlaying precious stones here and there.

The word manuscript translates itself by dividing into two parts, "manu" by

The oldest known illustration of infantile paralysis.

hand and "script" written. It is easy to see why only one copy was usually made, the expense plus the painstaking labor involved too often being difficult hurdles to overcome. However, if the text was something for which there was a demand (often this would be a medical or surgical text) custom demanded that it be available for consultation by those needing to do so. It was, therefore, placed in a library, usually that of the wealthy patron who had paid the costs. A hand-forged, heavy iron chain was attached to it, so that one might consult it but could not carry it away. Could this be a reflection on the people and the times?

Many chapters, even a volume or two, can be written about chain books but very few of them were of surgical import. Two or three of them had extensive rules of daily hygiene, chapters titled "Ars Vivendi," The Art of Living.

There is much of romance and imagination in the acquisition of a papyrus. For example, take the swarthy stranger with the intriguing wink who approached Ebers and swore that he had found the papyrus resting between the legs, under the scrotum of a mummy that had been unearthed on an expedition with which he had served as an interpreter. Chances are a native had come up with the find and the wily one took over from there, concealing the papyrus in the voluminous folds of his garment. Maybe he was even kind enough to give the finder a few shekels and tell him to get on his way and forget that he had ever seen anything.

October, 1949

The Smith surgical papyrus was obtained legitimately and it was only a question of bargaining and price. The Hearst papyrus passed through many hands and, as expected, found its way into a rich man's collection, but at a fancy price.

Another papyrus of later day, about 400 B.C., containing more medical lore than surgical interest, was found by a well known book collector as he visited the library of a Moravian Monastery. Coming down a ladder from a high shelf, a monk passed with a basket full of sheets which he threw into a fireplace preparatory to building a fire. Before he could light it, the book collector picked up a couple of the sheets and almost passed out in a fit of apoplexy. Several baskets of similar sheets had been burned on previous days. In this one particular basket alone was the original New Testament written in Greek, many, many pages of an old herbal, a "philosophia" and an "Ars Cirurgia." Elaborate on that happening a few times using a free play on the imagination; what may we have as a final result?

Take a look at the cupidity of man. When the book collector offered to buy the sheets, the monks became suspicious, retrieved the whole thing, basket and all, and would not sell at any price. What was that surgical text? We'll never know.

K. LIAWAAG recommends partial pericardiectomy for constrictive pericarditis and he has had several successful results. The author likes the dorsolateral transpleural incision since this gives an excellent approach to the heart. He advises that the operation be performed *before* an unchangeable pathologic condition develops in the heart muscle and liver; it is a good suggestion. A. Yodice studied seven cases of Pick's diseases (compressive pericarditis) and reports that tuberculosis was the etiologic agent. As the fibrosis increases, the diastolic action of the heart is interfered with, Yodice reminds us; and this is followed by enlargement of the liver and, later, portal hypertension with ascites. It is for these reasons that Liawaag heartily recommends that ample partial pericardiectomy be done *early* before the onset of these irreversible pathologic changes. (*Richard A. Leonardo, M.D.*)

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(*continued from page 26*)

"Yes, I am in favor of your idea but with emphasis on well delineated illustrations, graphs and figures with each paper. We all know that it is more difficult to prepare such a short, concise paper than the long drawn out lengthy article. For that reason it is important that a good bibliography be mandatory. One is apt to boil down portions or even a whole paper in a streamlined fashion and totally forget or purposely avoid credit due to others."

"Today more than ever one has to budget his time, and I know of no better place to start than in our medical journals. All of us who are teaching have to keep abreast with all of the literature in the many medical journals published, and any saving of time will accrue to our benefit."

"Many thanks for the reprint from The American Journal of Surgery. I think it is an excellent point, well taken. I agree that all papers cannot be so handled, but the majority of them can and should be. Most papers make about one point, and this can be very easily condensed, along the lines which you have indicated."

"Am heartily in favor of the idea. There will be some scientific papers which are new and will require both extent and facts in order to cover the 'prospecting' which is necessary in arriving at scientific conclusions. However, those papers which are confirmatory or which simply add to an already extensive experience can really be cut down and to a minimum. This will require more time on the part of the writer which is particularly good in that he can ask his assistants to think through and condense their evidence which is usually largely confirmatory."

"Apropos of the publication of condensed papers, I think probably there is a place for such papers, but to me it should be in either a section of a journal, as suggested by the editor of The American Journal of Surgery in the addendum which he put to your editorial of May, 1949, in a similar way that papers are abstracted and presented in a section of *S., G. & O., J. A. M. A.* and in the various so-called abstract journals."

"Generally speaking, I think that you will find that each surgical journal serves a very definite purpose, has a very definite program of publication and a very definite idea is held by the editors as to the types of papers which are suitable for acceptance."

"I think it is high time we started streamlining medical papers and I shall begin immediately on my own. For a number of years I have made a practice of reading short articles and looking at only the summaries of the long ones. I think most of us could get our thoughts into very much shorter space, use fewer words and attract more readers. You are exactly right. Go right ahead with it, and I hope you will interest all the men who are writing papers. Thanks for the reprint calling attention to this important matter."

"So far as we are concerned up here, we would utter loud hosannas of delight if you decided to tell Dr. Jackson that you approve of his idea. If papers in general were streamlined as he suggests, the onerous vicissitudes of toil in the Siberian salt mines up here would be infinitely lessened, and the inevitable onset of my own cerebral arteriosclerosis would be delayed by at least fifteen years.

"I hope these manifestations will add up to some definite progress in the direction advocated by Dr. Jackson."

"I think you are correct re: streamlining medical articles. I have often thought if they were printed as we must give them in 5 to 10 minutes, it would save lots of space, time, etc."

"I received your letter and the reprint of your article entitled 'Time to Streamline Medical Papers' in which sentiment I agree thoroughly."

Naturally, not every article lends itself to streamlining. Many papers must be done "in full," but it is obvious that many articles originally fifteen or twenty double spaced manuscript pages can be cut to seven to twelve manuscript pages without weakening the message the author wishes to convey. (At least omit History, Anatomy, Physiology, etc.) In

(*continued on page 40*)

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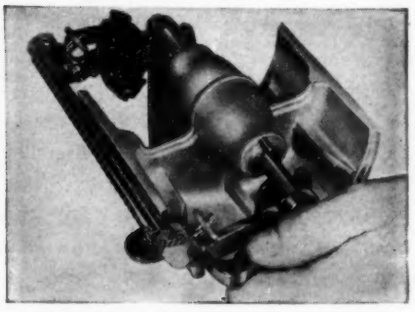

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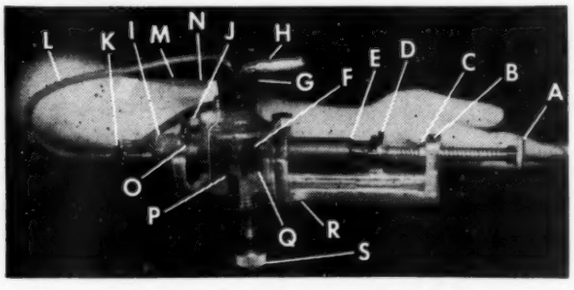

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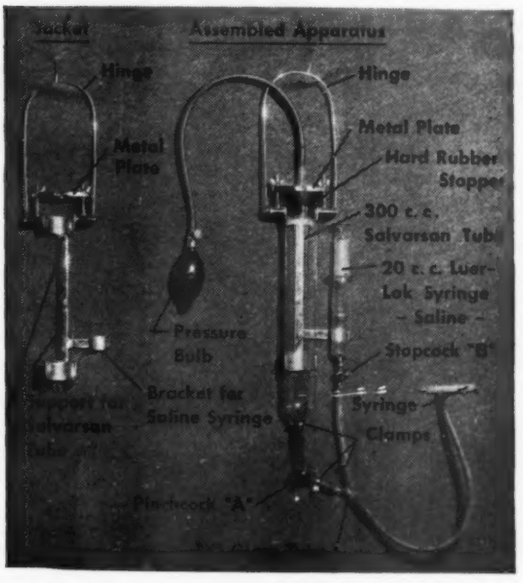

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Outside the Ivory Tower

(*continued from page* 38)

fact, cutting to the bone, in the majority of instances, tends to make the article stronger, more readable, and the intended punch or message gets over clear cut and impresses itself on the reader. We went over a backlog of accepted material. Due to many factors beyond our control we discovered the backlog was beyond all sensible size. Upon rereading this mountain of material we saw that most of it could be shortened and in this way we would get up to date. We wrote many authors asking if they could shorten or streamline their material. All cooperated and complied with good will except two individuals who wrote us testy, ill-mannered letters. At the present time many streamlined articles are far from what we ultimately desire but with time and practice we believe a pattern will be set and that this type of paper will have a wide appeal and become a specialized type of scientific communication.

WHERE it came from we have no idea. In our envelope where we deposit clippings, releases and odds and ends for this column was a typewritten half page dated, August 1st. In part it reads: " . . . Attlee is sick in bed with chills and fever. Sir Stafford Cripps has had bad indigestion and Foreign Minister Bevin has high blood pressure. . . . Attlee is weathering the storm in England but the other two have dusted the *socialized medicine* of England off their heels. Sir Stafford is in a Swiss Clinic having his stomach overhauled. Bevin is getting his blood pressure fixed up at Evian, France. . . . Only one had the courage to stay home and take his 'medicine.' The other two ran away from 'socialized medicine a la Britain' to get the orthodox variety. Of course, they are a little more fortunate than the ordinary Britisher, who cannot run out on it. . . . Odd, isn't it?"

AN outstanding book comes out in a second edition. It is "Essentials of Gynecology" by Leo Brady, M.D., F.A.C.S., Ethna Louise Kurtz, R.N. and Eileen McLaughlin, B.S., R.N. The first edition came out in 1941 when it enjoyed wide popularity and deservedly so. It is essentially a text for student and operating room nurses and we can think of no better work on this subject. It could also be studied with profit by senior medical students and hospital interns. (In fact, many general practitioners a bit on the rusty side concerning this subject might take off two or three nights and wander through its pages.) It is good reading. The illustrations are all one would wish for; they serve their purpose and are not "fillers." We mark this second edition "A-I," one of the tops in its field. The cost is $3 and The Macmillan Company is the publisher.

WARREN H. COLE, M.D., F.A.C.S., Professor and Head of the Department of Surgery, University of Illinois College of Medicine, has done a finished editorial job in "Operative Technic in General Surgery." There is an Introduction by Dr. Frank H. Lahey. Thirty-four authors, everyone eminent in his domain and particular surgical field, have offered the student and reader a well rounded and complete volume. Some of the subjects covered are: Wound Healing and the Care of Wounds; Hemorrhage and Shock; Burns; Preoperative and Postoperative Care; Amputations; The Face, Mouth and Jaws; The Esophagus; Abdominal Incisions; Surgery of Stomach and Duodenum; Gastric Vagotomy in the Treatment of Peptic Ulcer; Surgery of Small Intestine; The Pancreas and Adrenal; The Gallbladder and Bile Ducts; The Liver and Subphrenic Space; The Colon and Appendix; The Lower Part of the Sigmoid, the Rectum and Anus; Lymphatic System, Spleen and Portal Hypertension; The Lymphatic System; Splenectomy; The Surgery of Portal Hypertension; Abdominal Hernia; The Breast; The Thyroid and Parathyroid Glands; The Muscles, Fasciae, Tendons and Bursae; The Blood Vessels; Surgery of the Hand and Its Tendons; and The Skin and Subcutaneous Tissue. This Volume contains 988 pages, 1200 figures and an index. A second volume on "Specialty Surgery" is supposed to appear early this Fall. The two volumes cost $30.00 and are published by Appleton-Century-Crofts Company.

ANOTHER work above average is "Essentials of Orthopedics" by Philip Wiles, M.S., F.R.C.S., F.A.C.S. It is a solid work containing 486 pages, 365 text figures, with 7 colored plates and should be in every orthopedist's library; it is a book that every intern resident and many surgeons would do well to read. It is published by The Blakiston Company.

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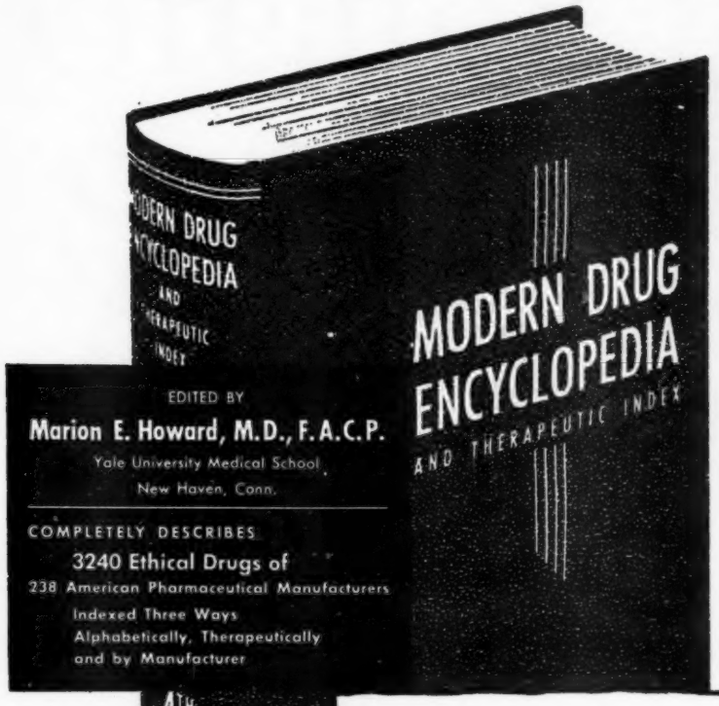

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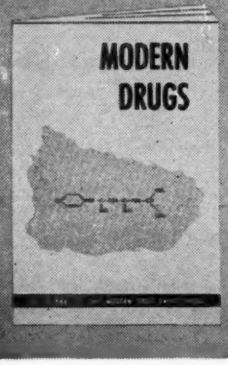

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1. Grimson, Marzoni, Reardon and Hendrix: Ann. of Surg., 127: 5, May, 1948.
2. Reich, N. E.: Med. Times, Jan., 1949.

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